



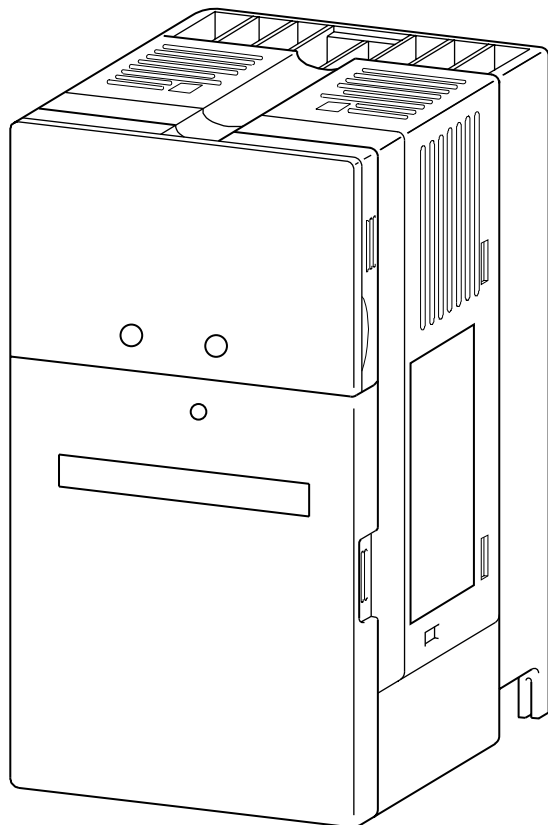
# TRANSISTORIZED INVERTER

## FR-E500

# INSTRUCTION MANUAL

*DeviceNet*  
CONFORMANCE TESTED™

## FR-E520-0.1KND to 7.5KND



**OUTLINE** Chapter 1

**INSTALLATION  
AND WIRING** Chapter 2

**OPERATION/  
CONTROL** Chapter 3

**PARAMETERS** Chapter 4

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FUNCTIONS** Chapter 5

**SPECIFICATIONS** Chapter 6

Thank you for choosing the Mitsubishi Transistorized inverter.

This instruction manual gives handling information and precautions for use of this equipment.

Incorrect handling might cause an unexpected fault. Before using the inverter, please read this manual carefully to use the equipment to its optimum.

Please forward this manual to the end user.

## **This section is specifically about safety matters**

Do not attempt to install, operate, maintain or inspect the inverter until you have read through this instruction manual and appended documents carefully and can use the equipment correctly.

Do not use the inverter until you have a full knowledge of the equipment, safety information and instructions.

In this manual, the safety instruction levels are classified into "WARNING" and "CAUTION".



Assumes that incorrect handling may cause hazardous conditions, resulting in death or severe injury.



Assumes that incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause physical damage only.

Note that even the CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.

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# SAFETY INSTRUCTIONS

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## 1. Electric Shock Prevention

 **WARNING**

- While power is on or when the inverter is running, do not open the front cover. You may get an electric shock.
- Do not run the inverter with the front cover removed. Otherwise, you may access the exposed high-voltage terminals or the charging part of the circuitry and get an electric shock.
- If power is off, do not remove the front cover except for wiring or periodic inspection. You may access the charged inverter circuits and get an electric shock.
- Before starting wiring or inspection, switch power off, wait for more than 10 minutes, and check for residual voltage with a meter (refer to chapter 2 for further details) etc.
- Earth the inverter.
- Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.
- Always install the inverter before wiring. Otherwise, you may get an electric shock or be injured.
- Operate the switches and potentiometers with dry hands to prevent an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise, you may get an electric shock.
- Do not change the cooling fan while power is on.  
It is dangerous to change the cooling fan while power is on.
- While power is on, do not move the node address setting switches. Doing so can cause an electric shock.

## 2. Fire Prevention

 **CAUTION**

- Mount the inverter and brake resistor on an incombustible surface. Installing the inverter directly on or near a combustible surface could lead to a fire.
- If the inverter has become faulty, switch off the inverter power. A continuous flow of large current could cause a fire.
- When a brake resistor is used, use an alarm signal to switch power off. Otherwise, the brake resistor will overheat abnormally due a brake transistor or other fault, resulting in a fire.
- Do not connect a resistor directly to the DC terminals P (+), N (-). This could cause a fire.

### 3. Injury Prevention

#### CAUTION

- Apply only the voltage specified in the instruction manual to each terminal to prevent damage etc.
- Ensure that the cables are connected to the correct terminals. Otherwise, damage etc. may occur.
- Always make sure that polarity is correct to prevent damage etc.
- While power is on and for some time after power-off, do not touch the inverter or brake resistor as they are hot and you may get burnt.

### 4. Additional instructions

Also note the following points to prevent an accidental failure, injury, electric shock, etc.

#### (1) Transportation and installation

#### CAUTION

- When carrying products, use correct lifting gear to prevent injury.
- Do not stack the inverter boxes higher than the number recommended.
- Ensure that installation position and material can withstand the weight of the inverter. Install according to the information in the Instruction Manual.
- Do not operate if the inverter is damaged or has parts missing.
- When carrying the inverter, do not hold the front cover or accessory cover.
- Do not stand or rest heavy objects on the inverter.
- Check the inverter mounting orientation is correct.
- Prevent screws, wire fragments or other conductive bodies or oil or other flammable substance from entering the inverter.
- Do not drop the inverter, or subject it to impact.
- Use the inverter under the following environmental conditions:

Environment	Ambient temperature	Constant torque : -10°C to +50°C (non-freezing)
	Ambient humidity	90%RH or less (non-condensing)
	Storage temperature	-20°C to +65°C *
	Ambience	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
	Altitude, vibration	Maximum 1000m above sea level for standard operation. After that derate by 3% for every extra 500m up to 2500m (91%). 5.9m/s <sup>2</sup> or less (conforming to JIS C 0040)

\* Temperatures applicable for a short time, e.g. in transit.

## (2) Wiring

### CAUTION

- Do not fit capacitive equipment such as a power factor correction capacitor, noise filter or surge suppressor to the output of the inverter.
- The connection orientation of the output cables U, V, W to the motor will affect the direction of rotation of the motor.

## (3) Trial run

### CAUTION

- Check all parameters, and ensure that the machine will not be damaged by a sudden start-up.

## (4) Operation

### WARNING

- When you have chosen the retry function, stay away from the equipment as it will restart suddenly after an alarm stop.
- The load used should be a three-phase induction motor only. Connection of any other electrical equipment to the inverter output may damage the equipment.
- Do not modify the equipment.

### CAUTION

- The electronic overcurrent protection does not guarantee protection of the motor from overheating.
- Do not use a magnetic contactor on the inverter input for frequent starting/stopping of the inverter.
- Use a noise filter to reduce the effect of electromagnetic interference. Otherwise nearby electronic equipment may be affected.
- Take measures to suppress harmonics. Otherwise power harmonics from the inverter may heat/damage the power capacitor and generator.
- When parameter clear or all clear is performed, each parameter returns to the factory setting. Re-set the required parameters before starting operation.
- The inverter can be easily set for high-speed operation. Before changing its setting, fully examine the performances of the motor and machine.
- In addition to the inverter's holding function, install a holding device to ensure safety.
- Before running an inverter which had been stored for a long period, always perform inspection and test operation.

## (5) Emergency stop

### CAUTION

- Provide a safety backup such as an emergency brake which will prevent the machine and equipment from hazardous conditions if the inverter fails.

## (6) Maintenance, inspection and parts replacement

### CAUTION

- Do not carry out a megger (insulation resistance) test on the control circuit of the inverter.

## (7) Disposing of the inverter

### CAUTION

- Treat as industrial waste.

## (8) General instructions

Many of the diagrams and drawings in this instruction manual show the inverter without a cover, or partially open. Never operate the inverter like this. Always replace the cover and follow this instruction manual when operating the inverter.

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# CHAPTER 1

# OUTLINE

This chapter gives information on the basic "outline" of this product.

Always read the instructions before using the equipment.

1.1 Pre-Operation Information .....	1
1.2 Basic Configuration.....	3
1.3 Structure .....	4

## <Abbreviations>

- PU  
Parameter unit (FR-PU04)
- Inverter  
Mitsubishi transistorized inverter  
FR-E500 series
- FR-E500KND  
Mitsubishi transistorized inverter  
FR-E500 series DeviceNet type
- Pr.  
Parameter number

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**(2) Preparation of instruments and parts required for operation**

Instruments and parts to be prepared depend on how the inverter is operated. Prepare equipment and parts as necessary. (Refer to page 49.)

**(3) Installation**

To operate the inverter with high performance for a long time, install the inverter in a proper place, in the correct direction, with proper clearances. (Refer to page 9.)

**(4) Wiring**

Connect the power supply, motor and operation signals (control signals) to the terminal block. Note that incorrect connection may damage the inverter and peripheral devices. (See page 11.)

**(5) Ground**

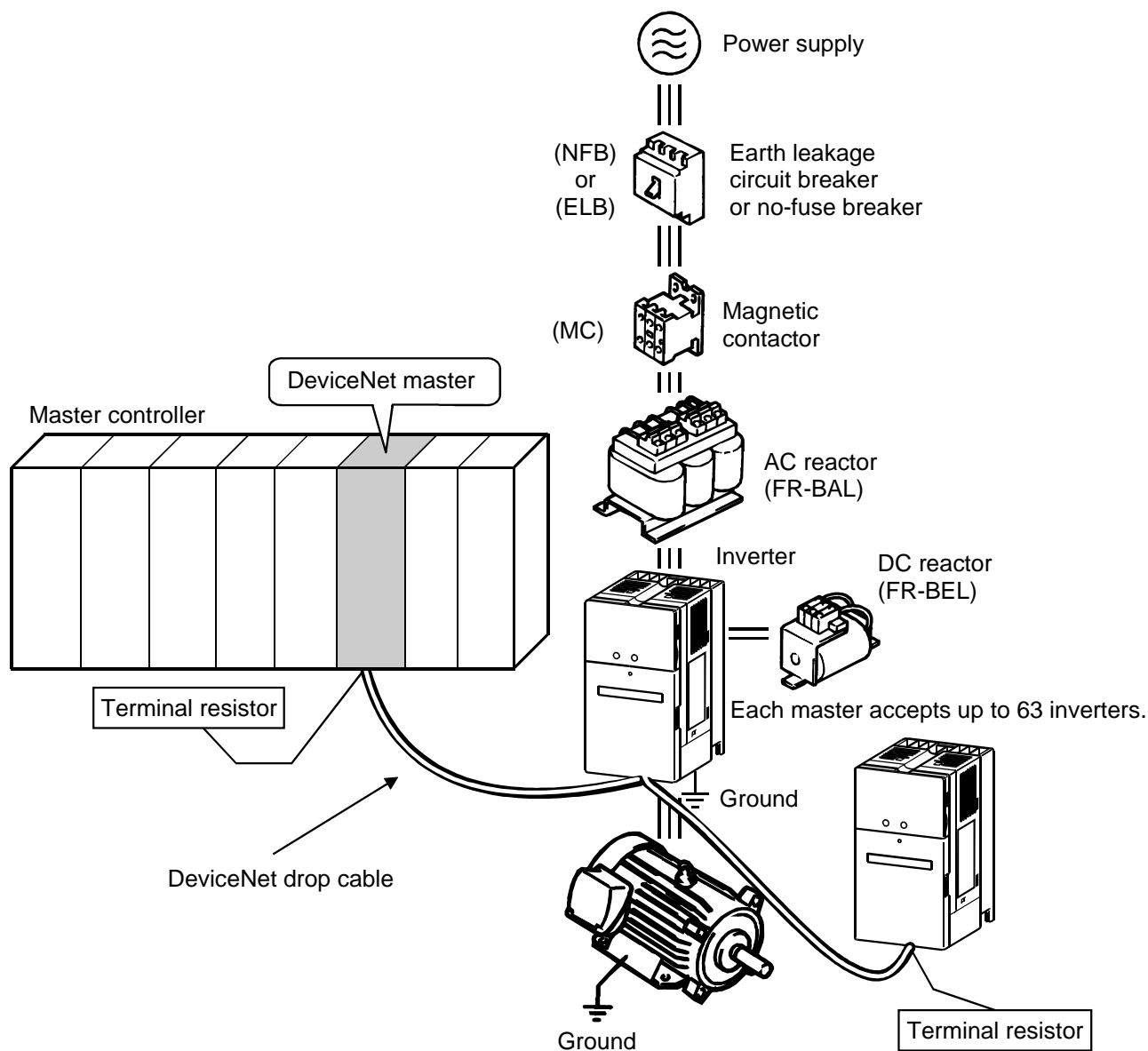
To prevent an electric shock, always ground the motor and inverter.

The ground wiring from the power line of the inverter as an induction inverter reduction technique is recommended to be run by returning it to the ground terminal of the inverter. (Refer to page 40 for examples of noise countermeasures.)

# 1.2 Basic Configuration

## 1.2.1 Basic configuration

The following devices are required to operate the inverter. Proper peripheral devices must be selected and correct connections made to ensure proper operation. Incorrect system configuration and connections can cause the inverter to operate improperly, its life to be reduced considerably, and in the worst case, the inverter to be damaged. Please handle the inverter properly in accordance with the information in each section as well as the precautions and instructions of this manual. (For connections of the peripheral devices, refer to the corresponding manuals.)



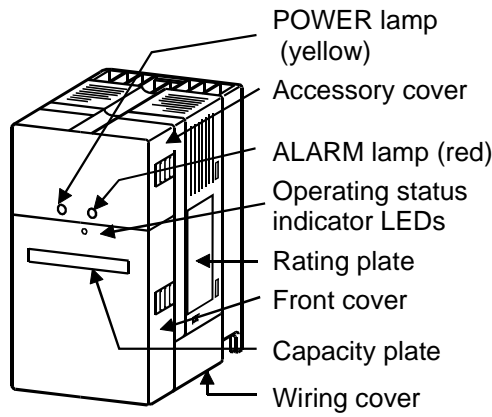
### Harmonic Suppression Guideline

The "harmonic suppression guideline for household appliances and general-purpose products" issued by ex-Ministry of International Trade and Industry (present Ministry of Economy, Trade and Industry) in September, 1994 applies to the 3.7K and less models. By installing the power factor improving reactor (FR-BEL or FR-BAL), inverters comply with the "harmonic suppression techniques for transistorized inverters (input current 20A or less)" established by the Japan Electrical Manufacturers' Association.

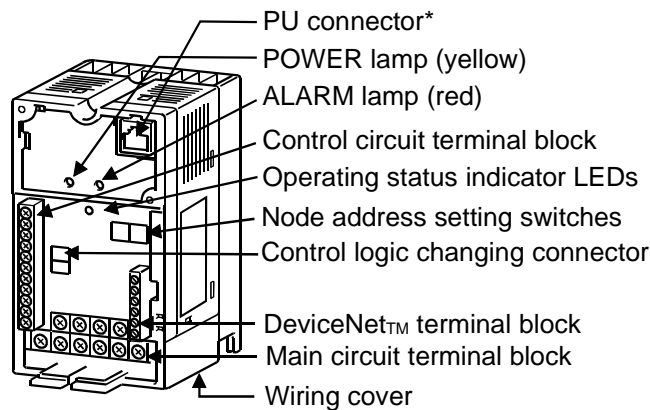
# 1.3 Structure

## 1.3.1 Appearance and structure

### (1) Front view

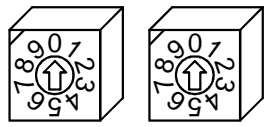


### (2) Without accessory cover and front cover



\* Use the PU connector for the FR-PU04 (option) and RS-485 communication.

## 1.3.2 Functions

Name	Function
Node address setting switches  SW1(x10) SW2(x1)	Used to set the inverter node address between 0 and 63. For details, refer to page 47, 51.
POWER lamp (yellow)	Lit to indicate that power is input (present).
ALARM lamp (red)	Lit to indicate that a protective function is activated.
Operating status indicator LED	The operating status indicator LED is a 2 color (Red and Green) LED. For details on the operating status please refer to page 25 which details the system state and corresponding LED status.

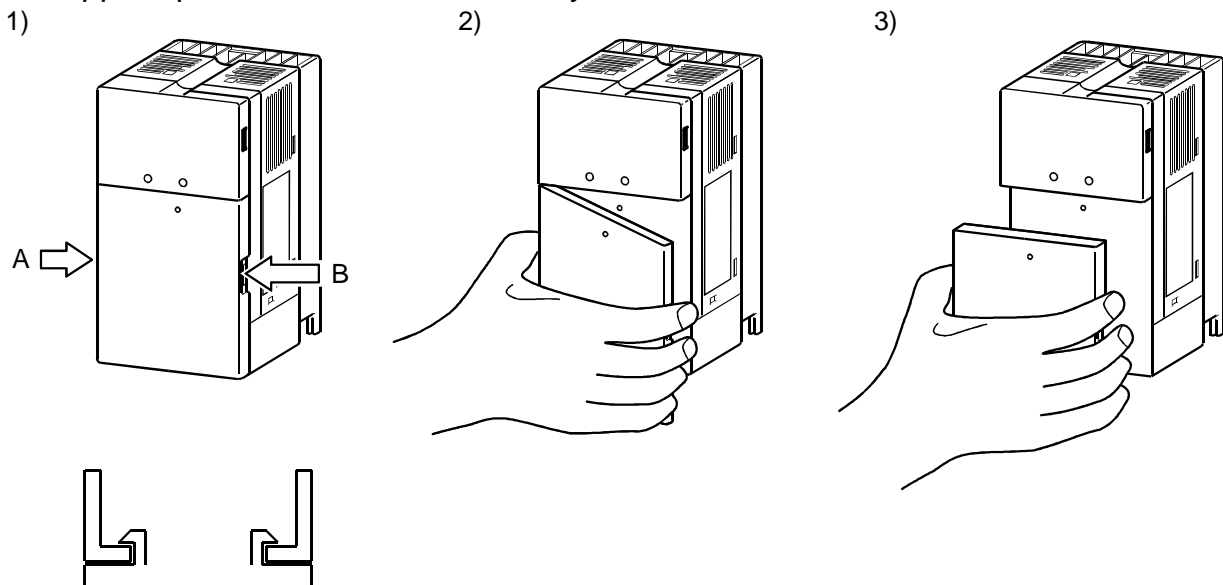


### 1.3.3 Removal and reinstallation of the front cover

● **Removal**

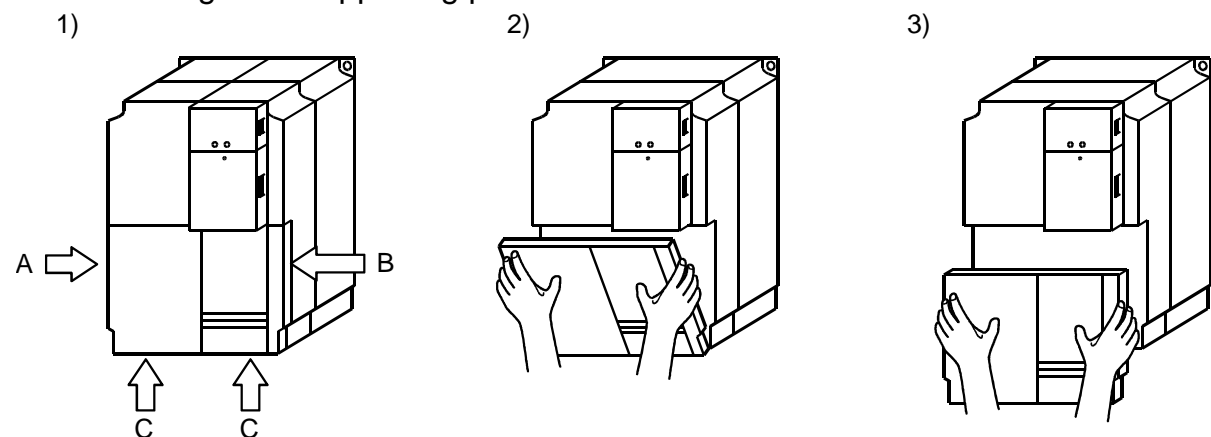
**(For the FR-E520-0.1KND to 3.7KND)**

The front cover is secured by catches in positions A and B as shown below. Push either A or B in the direction of arrows, and using the other end as a support, pull the front cover toward you to remove.



**(For the FR-E520-5.5KND, 7.5KND)**

The front cover is fixed with catches in positions A, B and C. Push A and B in the directions of arrows at the same time and remove the cover using C as supporting points.



● **Reinstallation**

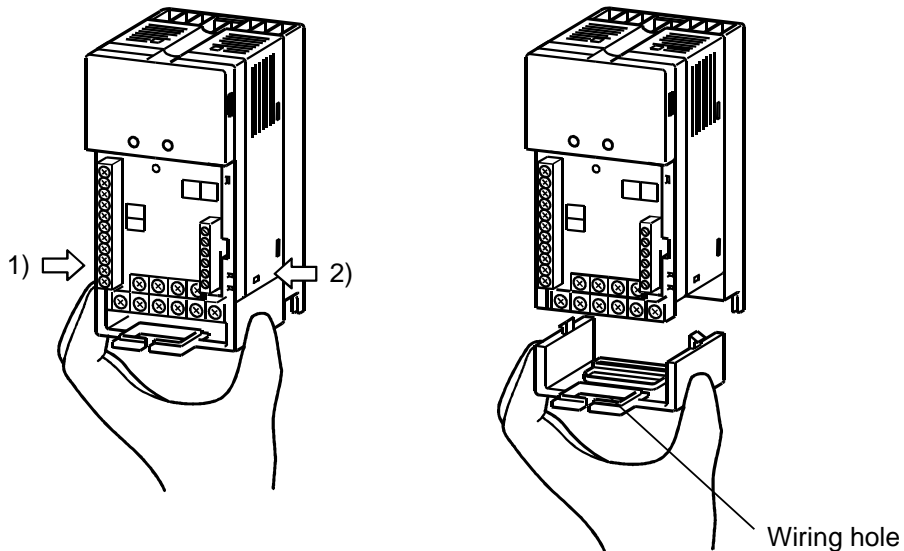
When reinstalling the front cover after wiring, fix the catches securely. With the front cover removed, do not switch power on.

- Note: 1. Make sure that the front cover has been reinstalled securely.  
 2. The same serial number is printed on the capacity plate of the front cover and the rating plate of the inverter. Before reinstalling the front cover, check the serial numbers to ensure that the cover removed is reinstalled to the inverter from where it was removed.

### 1.3.4 Removal and reinstallation of the wiring cover

#### ● Removal

The wiring cover is fixed by catches in positions 1) and 2). Push either 1) or 2) in the direction of arrows and pull the wiring cover downward to remove.



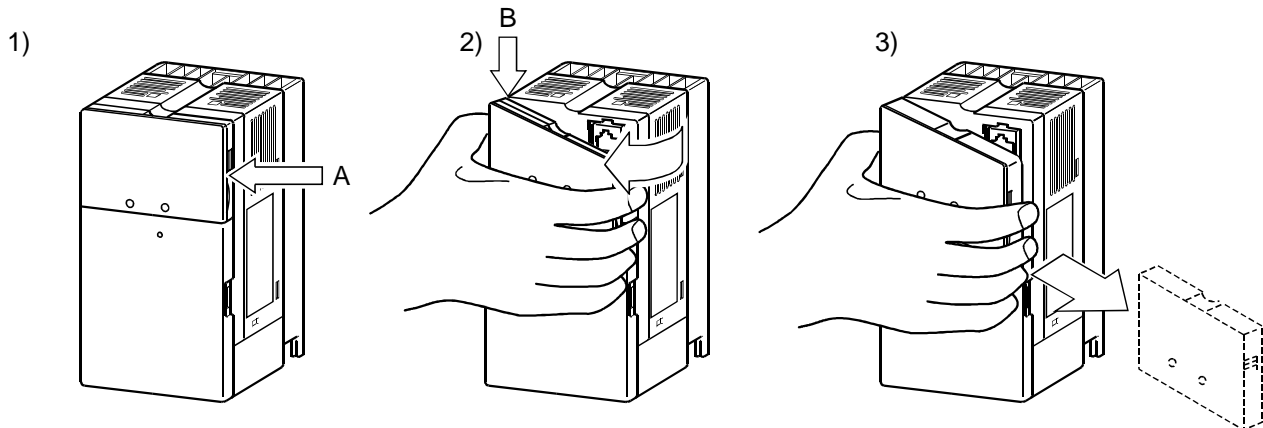
#### ● Reinstallation

Pass the cables through the wiring hole and reinstall the cover in the original position.

### 1.3.5 Removal and reinstallation of the accessory cover

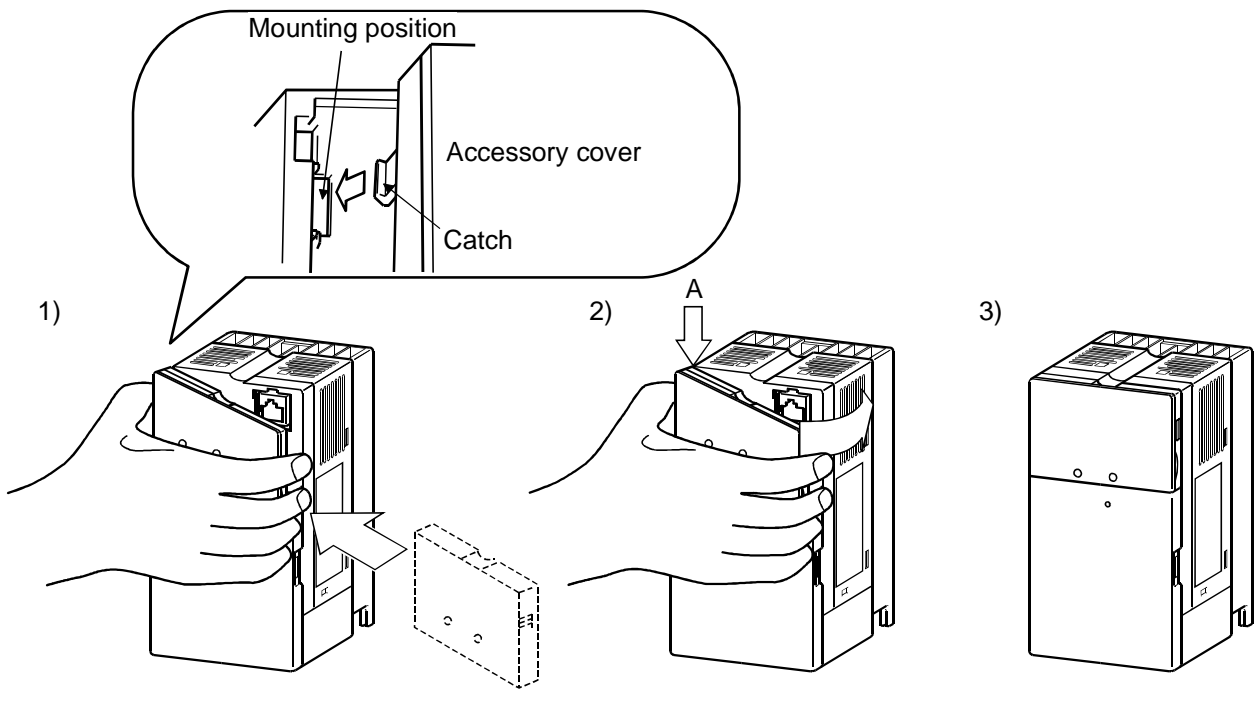
● **Removal of the control panel**

Hold down the portion A indicated by the arrow and lift the right hand side using the portion B indicated by the arrow as a support, and pull out the control panel to the right.

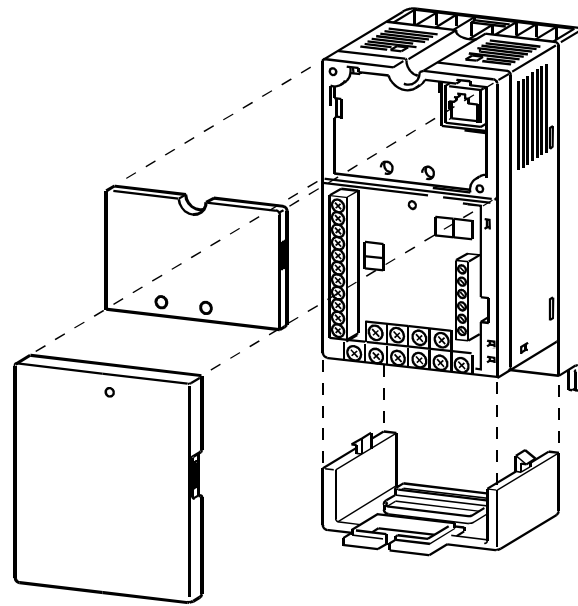


● **Installation**

Insert the mounting catch (left hand side) of the accessory cover into the mounting position of the inverter and push in the right hand side mounting catch to install the control panel.



### 1.3.6 Exploded view



# CHAPTER 2

## INSTALLATION AND WIRING

This chapter gives information on the basic "installation and wiring" for use of this product.

Always read the instructions in this chapter before using the equipment.

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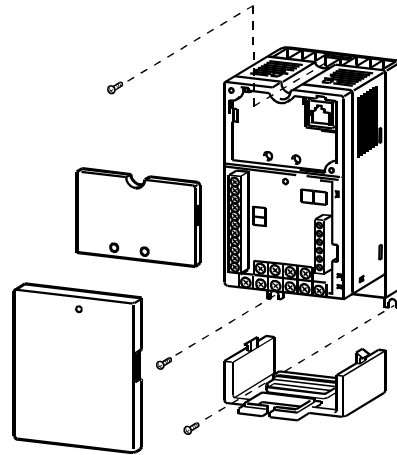
Chapter 5

Chapter 6

## 2.1 Installation

### 2.1.1 Instructions for installation

When mounting any of the FR-E520-0.1KND to 0.75KND, remove the accessory cover, front cover and wiring cover.



- 1) Handle the unit carefully.  
The inverter uses plastic parts. Handle it gently to protect it from damage. Also, hold the unit with even strength and do not apply too much strength to the front cover alone.
- 2) Install the inverter in a place where it is not affected by vibration easily ( $5.9\text{m/s}^2$  maximum).  
Note the vibration of a cart, press, etc.
- 3) Note on ambient temperature.  
The inverter life is under great influence of ambient temperature. In the place of installation, ambient temperature must be within the permissible range  $-10^{\circ}\text{C}$  to  $+50^{\circ}$ . Check that the ambient temperature is within that range in the positions shown in figure 3).
- 4) Install the inverter on a non-combustible surface.  
The inverter will be very hot (maximum about  $150^{\circ}\text{C}$ ). Install it on a non-combustible surface (e.g. metal). Also leave sufficient clearances around the inverter.
- 5) Avoid high temperature and high humidity.  
Avoid direct sunlight and places of high temperature and high humidity.

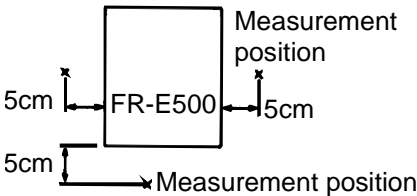
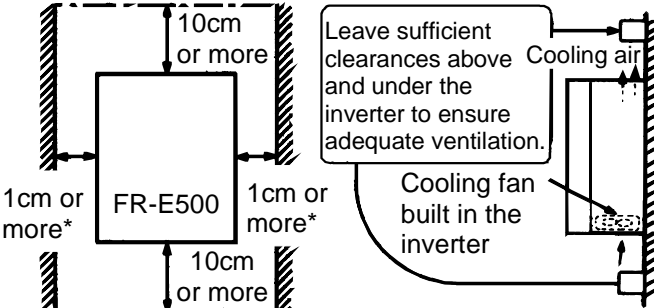
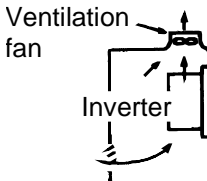
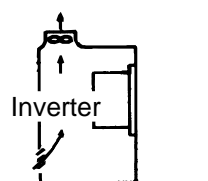
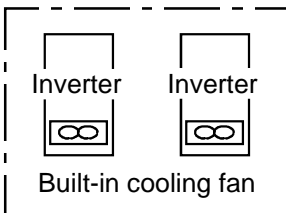
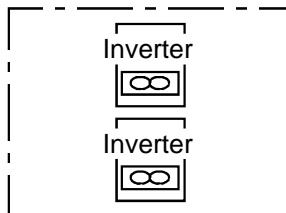
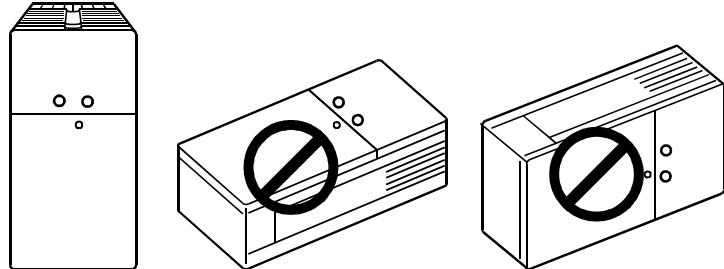
6) Avoid places where the inverter is exposed to oil mist, flammable gases, fluff, dust, dirt etc.

Install the inverter in a clean place or inside a "totally enclosed" panel which does not accept any suspended matter.

7) Note the cooling method when the inverter is installed in an enclosure.

When two or more inverters are installed or a ventilation fan is mounted in an enclosure, the inverters and ventilation fan must be installed in proper positions with extreme care taken to keep the ambient temperatures of the inverters with the permissible values. If they are installed in improper positions, the ambient temperatures of the inverters will rise and ventilation effect will be reduced.

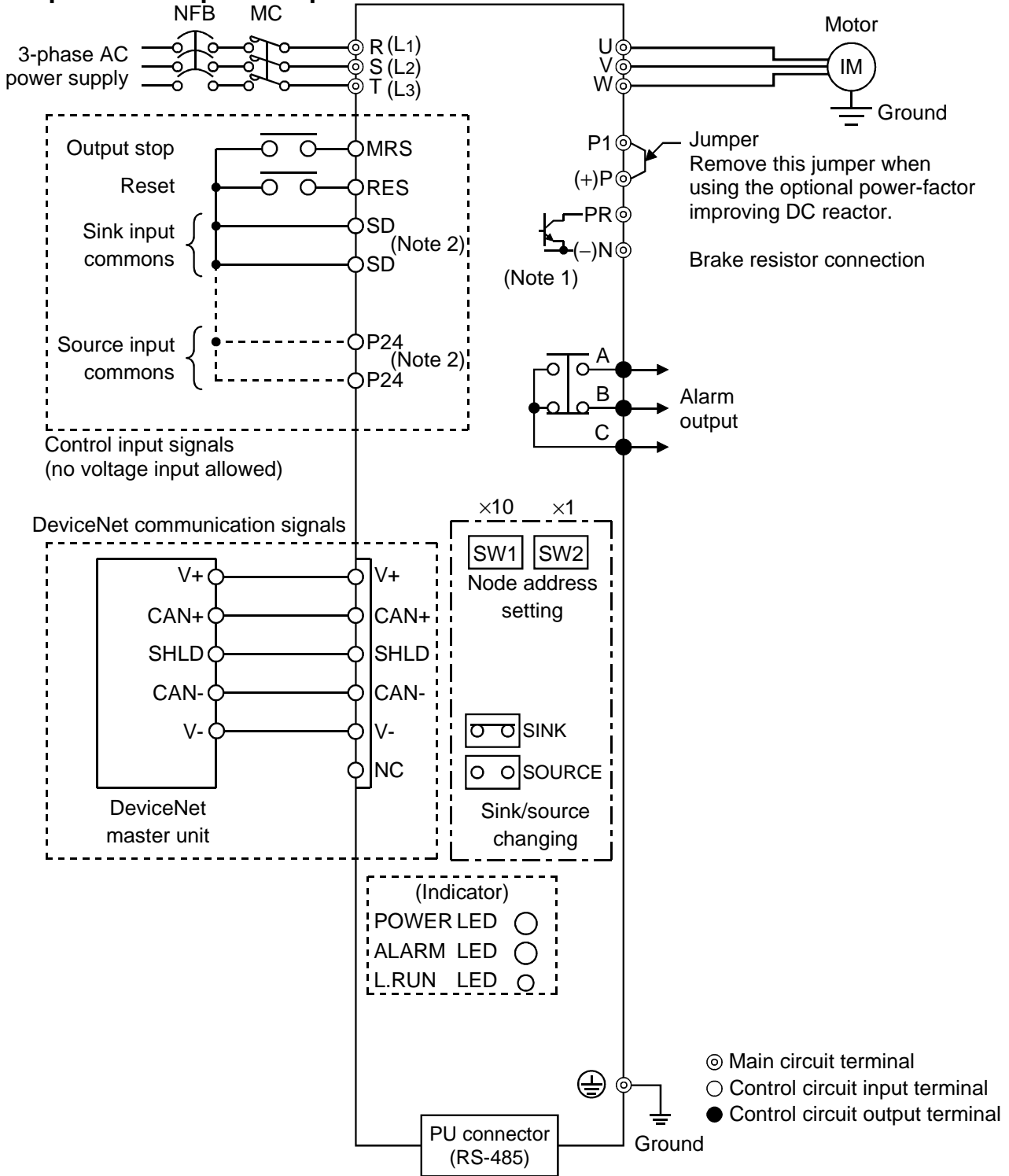
8) Install the inverter securely in the vertical direction with screws or bolts.

<p>3) Note on ambient temperatures</p> 	<p>4) Clearances around the inverter</p>  <p>*5cm or more for 5.5K and 7.5K These clearances are also necessary for changing the cooling fan.</p>
<p>7) For installation in an enclosure</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>(Correct example)</p> </div> <div style="text-align: center;">  <p>(Incorrect example)</p> </div> </div> <p style="text-align: center;">Position of Ventilation Fan</p> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="text-align: center;">  <p>Built-in cooling fan</p> <p>(Correct example)</p> </div> <div style="text-align: center;">  <p>(Incorrect example)</p> </div> </div> <p style="text-align: center;">When more than one inverter is contained</p>	
<p>8) Vertical mounting</p> 	

# 2.2 Wiring

## 2.2.1 Terminal connection diagram


### ● 3-phase 200V power input



Note: 1. 0.1K and 0.2K do not contain a transistor.  
 2. Terminals SD and P24 are common terminals. Do not connect them to each other or to the earth.



**(1) Description of the main circuit terminals**

Symbol	Terminal Name	Description
R, S, T (L1, L2, L3)	AC power input	Connect to the commercial power supply. Keep these terminals unconnected when using the high power factor converter.
U, V, W	Inverter output	Connect a three-phase squirrel-cage motor.
P (+), PR	Brake resistor connection	Connect the optional brake resistor across terminals P-PR (+ - PR) (not for 0.1K and 0.2K).
P (+), N (-)	Brake unit connection	Connect the optional brake unit or high power factor converter.
P (+), P1	Power factor improving DC reactor connection	Disconnect the jumper from terminals P-P1 (+ - P1) and connect the optional power factor improving DC reactor.
	Ground	For grounding the inverter chassis. Must be earthed.

**(2) Description of the control circuit terminals**

Type	Symbol	Terminal Name	Description
Input signals	Contact input	MRS	Output halt Turn on the MRS signal (20ms or longer) to stop the inverter output. Used to shut off the inverter output to bring the motor to a stop by the electromagnetic brake.
		RES	Reset Used to reset the protective circuit activated. Turn on the RES signal for more than 0.1 second, then turn it off.
	P24	SD	Contact input common (sink) Common terminal for contact inputs for use in the sink input mode. In the sink input mode, connection with this terminal switches the signal on and disconnection switches it off.
		RES	Contact input common (source) Common terminal for contact inputs for use in the source input mode. In the source input mode, connection with this terminal switches the signal on and disconnection switches it off.
Output signals	Contact	A, B, C (note)	Alarm output Contact output indicating that the output has been stopped by the inverter protective function activated. 230VAC 0.3A, 30VDC 0.3A. Alarm: discontinuity across B-C (continuity across A-C), normal: continuity across B-C (discontinuity across A-C). Pr. 192 "A, B, C terminal (ABC) function selection" setting, changes the terminal functions.

Note : Wire the cables for application of voltages to the contact outputs so that they may be separated from the PLC power at the no-fuse breaker etc. If they are connected to the same power supply as is used by the PLC, the inverter cannot be changed during DeviceNet™ communication.

**(3) DeviceNet™ signals**

<b>Terminal Symbol</b>	<b>Terminal Name</b>	<b>Description</b>
V+ (Red) CAN+ (White) SHLD (Bare/nothing) CAN- (Blue) V- (Black)	DeviceNet™ communication and power signals	Connected with the master station and other slave stations to make DeviceNet™ communication.

**(4) RS-485 communication**

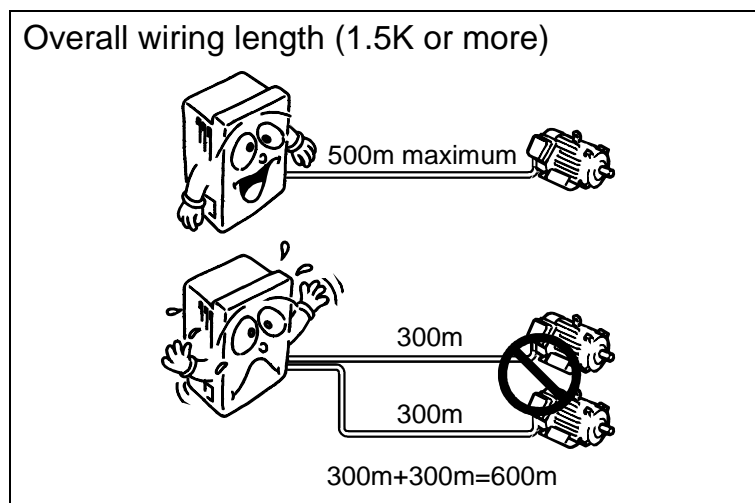
<b>Name</b>	<b>Description</b>
PU connector	<p>Communication can be made by the PU connector in accordance with RS-485.</p> <ul style="list-style-type: none"> <li>• Compliant standard: EIA Standard RS-485</li> <li>• Transmission form: Multidrop link system</li> <li>• Communication speed: Maximum 19200bps</li> <li>• Overall distance: 500m</li> </ul>

**2.2.2 Wiring of the main circuit**

**(1) Wiring instructions**

- 1) It is recommended to use insulation-sleeved solderless terminals for power supply and motor wiring.
- 2) Power must not be applied to the output terminals (U, V, W) of the inverter. Otherwise the inverter will be damaged.
- 3) After wiring, wire off-cuts must not be left in the inverter.  
Wire off-cuts can cause an alarm, failure or malfunction. Always keep the inverter clean.  
When drilling mounting holes in a control box etc., be careful so that chips and others do not enter the inverter.
- 4) Use thick cables to make the voltage drop 2% or less.  
If the wiring distance is long between the inverter and motor, a main circuit cable voltage drop will cause the motor torque to decrease, especially at the output of a low frequency. (A selection example for the wiring length of 20m is shown on page 16.)
- 5) For long distance wiring, the overcurrent protection may be activated improperly or the devices connected to the output side may misoperate or become faulty under the influence of a charging current due to the stray capacitance of the wiring. Therefore, the maximum overall wiring length should be as indicated in the following table. If the wiring length exceeds the value, it is recommended to set "1" in Pr. 156 to make the fast-response current limit function invalid. (When two or more motors are connected to the inverter, the total wiring length should be within the indicated value.)

Inverter Capacity	0.1K	0.2K	0.4K	0.75K	1.5K or more
Non-low acoustic noise mode	200m	200m	300m	500m	500m
Low acoustic noise mode	30m	100m	200m	300m	500m



- 6) Connect only the recommended optional brake resistor between the terminals P-PR (+ - PR). Keep terminals P-PR (+ - PR) of 0.1K or 0.2K open.  
 These terminals must not be shorted.  
 0.1K and 0.2K do not accept the brake resistor. Keep terminals P-PR (+ - PR) open.  
 Also, never short these terminals.
- 7) Electromagnetic wave interference  
 The input/output (main circuit) of the inverter includes harmonic components, which may interfere with the communication devices (such as AM radios) used near the inverter. In this case, install the FR-BIF optional radio noise filter (for use in the input side only) or FR-BSF01 or FR-BLF line noise filter to minimize interference.
- 8) Do not install a power capacitor, surge suppressor or radio noise filter (FR-BIF option) in the output side of the inverter.  
 This will cause the inverter to trip or the capacitor and surge suppressor to be damaged. If any of the above devices are installed, immediately remove them.
- 9) When rewiring after operation, make sure that the POWER lamp has gone off, and when more than 10 minutes has elapsed after power-off, check with a meter etc. that the voltage is zero. After that, start rewiring work. For some time after power-off, there is a dangerous voltage in the capacitor.

**Notes on Grounding**

- Leakage currents flow in the inverter. To prevent an electric shock, the inverter and motor must be grounded (200V class: class C grounding, grounding resistance 100Ω maximum).
- Use the dedicated ground terminal to ground the inverter. (Do not use the screw in the case, chassis, etc.)
- The ground cable should be as thick as possible. Its gauge should be equal to or larger than those indicted in the following table, and its length should be as short as possible. The grounding point should be as near as possible to the inverter to minimize the ground cable length.

(Unit: mm<sup>2</sup>)

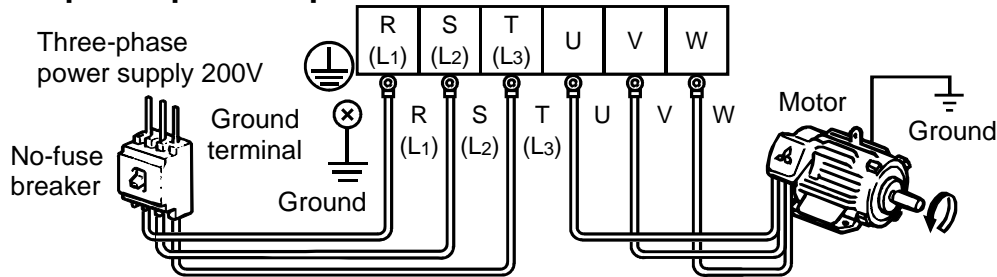
	Ground Cable Gauge
	200V class
2.2kW or less	2
3.7kW	3.5
5.5kW, 7.5kW	5.5

- Ground the motor on the inverter side using one wire of the 4-core cable.



**(4) Connection of the power supply and motor**

● **Three-phase power input**



The power supply cables must be connected to R, S, T (L1, L2, L3). If they are connected to U, V, W, the inverter will be damaged. (Phase sequence need not be matched.)

Connect the motor to U, V, W. In the above connection, turning on the forward rotation switch (signal) rotates the motor in the counterclockwise (arrow) direction when viewed from the load shaft.

**Note:** To ensure safety, connect the power input to the inverter via a magnetic contactor and earth leakage circuit breaker or no-fuse breaker, and use the magnetic contactor to switch power on-off.

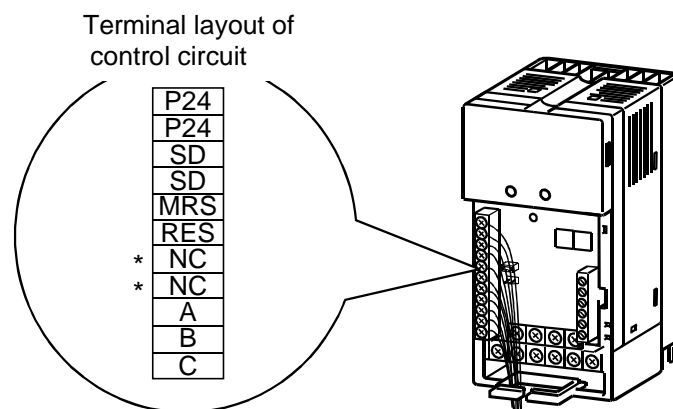
## 2.2.3 Wiring of the control circuit

### (1) Wiring instructions

- 1) Terminals SD and P24 are common to the I/O signals.  
Do not connect these common terminals together or do not earth these terminals to the ground.
- 2) Use shielded or twisted cables for connection to the control circuit terminals and run them away from the main and power circuits (including the 200V relay sequence circuit).
- 3) The frequency input signals to the control circuit are micro currents. When contacts are required, use two or more parallel micro signal contacts or a twin contact to prevent a contact fault.
- 4) It is recommended to use the cables of 0.3mm<sup>2</sup> to 0.75mm<sup>2</sup> gauge for connection to the control circuit terminals.
- 5) When bar terminals and solid wires are used for wiring, their diameters should be 0.9mm maximum. If they are larger, screw threads may be damaged during tightening.

### (2) Terminal block layout

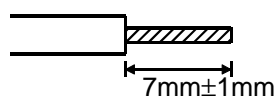
In the control circuit of the inverter, the terminals are arranged as shown below:



\*: Keep NC unconnected.

### (3) Wiring method

- 1) For wiring the control circuit, use cables after stripping their sheaths.  
Refer to the gauge printed on the inverter and strip the sheaths to the following dimensions. If the sheath is stripped too much, its cable may be shorted with the adjoining cable. If the sheath is stripped too little, the cable may come off.



- 2) When using bar terminals and solid wires for wiring, their diameters should be 0.9mm maximum. If they are larger, the threads may be damaged during tightening.
- 3) Loosen the terminal screw and insert the cable into the terminal.
- 4) Tighten the screw to the specified torque.  
Undertightening can cause cable disconnection or misoperation. Overtightening can cause damage to the screw or unit, leading to short circuit or misoperation.  
Tightening torque: 0.25N·m to 0.49N·m  
\*Use a screwdriver No. 0 to tighten.

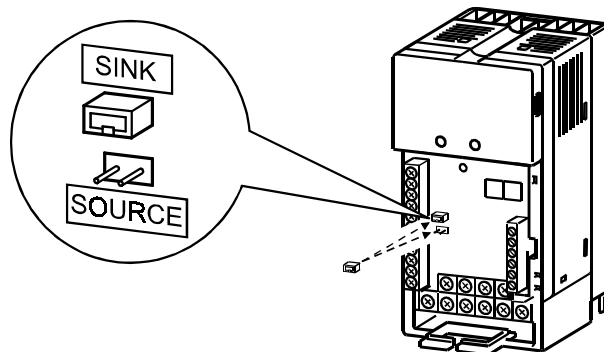
Note: When routing the stripped cables, twist them so that they do not become loose. In addition, do not solder it.

### **(4) Control logic changing**

The input signal logic is factory-set to the sink mode.

To change the control logic, the position of the connector beside the control circuit terminal block must be changed.

- 1) Use tweezers etc. to remove the connector in the sink logic position and fit it in the source logic position.  
Do this position changing before switching power on.



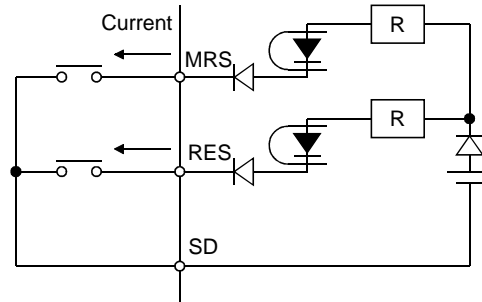
- Note:
1. Make sure that the front cover has been installed securely.
  2. The front cover has a capacity plate and the inverter a rating plate on it. Since these plates have the same serial numbers, always reinstall the removed cover to the inverter from where it was removed.
  3. Always install the sink-source logic changing connector in either of the positions. If two connectors are installed in these positions at the same time, the inverter may be damaged.



2) Sink logic type

- In this logic, a signal switches on when a current flows out of the corresponding signal input terminal.

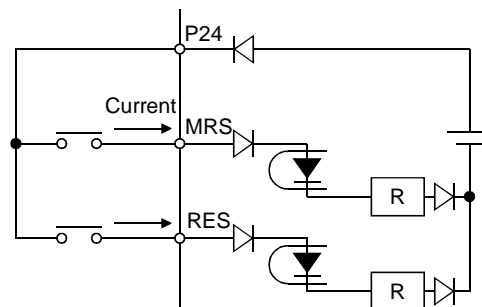
Terminal SD is common to the contact input signals.



3) Source logic type

- In this logic, a signal switches on when a current flows into the corresponding signal input terminal.

Terminal P24 is common to the contact input signals.

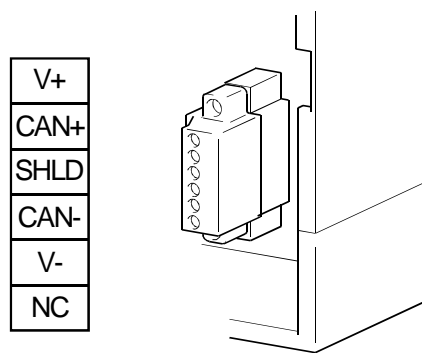


## 2.2.4 DeviceNet communication signal wiring

### (1) Terminal block layout

The terminal layout of the inverter's DeviceNet communication signals is as shown below.

Terminal screw size: M2.5



---

**CAUTION**

---

The DeviceNet terminal block is hard-wired. It is not removable.

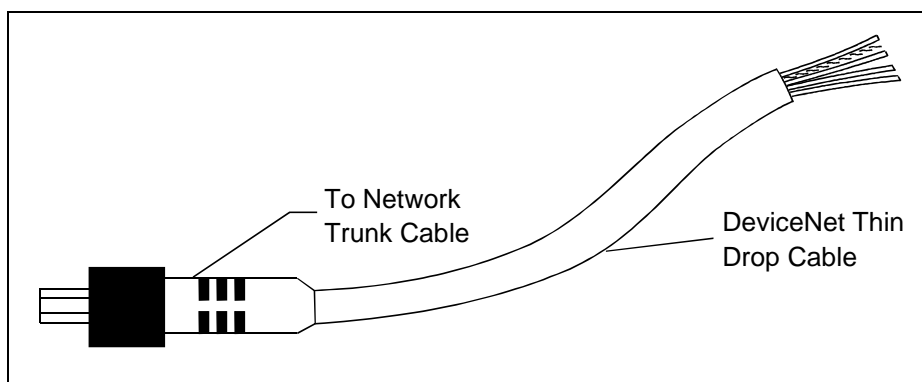
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### (2) Constructing DeviceNet Drop Cable

Use the DeviceNet drop cable to connect the inverter to the DeviceNet network. The drop cable consists of an ODVA-approved "thin" cable and a 6-pin connector to be plugged into the inverter's DeviceNet connector. The ODVA approved wire is a hard wire specification. Recommended parts are:

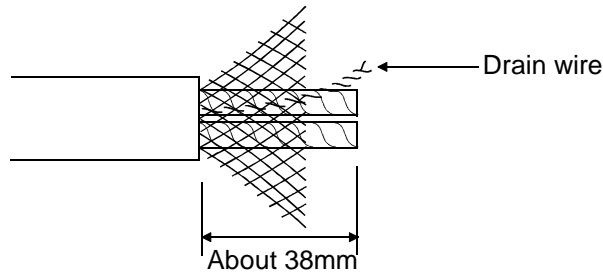
DeviceNet Thin Cable: Belden part number 3082A or equivalent.

Note: Maximum length of drop cable must not exceed 20 feet.

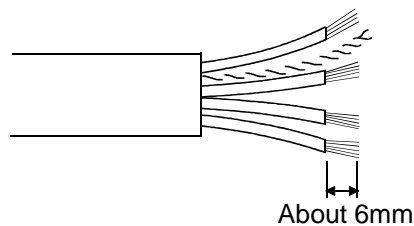


DeviceNet Cable

- 1) Strip off the drop cable sheath about 38mm and remove the shield net. In addition to the signal and power wires, there is one drain wire made by twisting the shield net.



- 2) Peel off the aluminum tapes which wraps the signal and power wires and strip the insulations about 6mm.

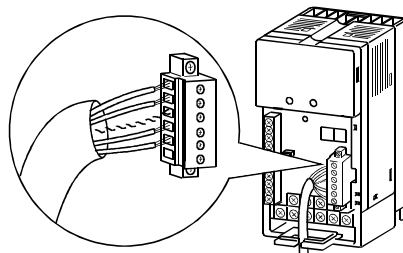


### REMARKS

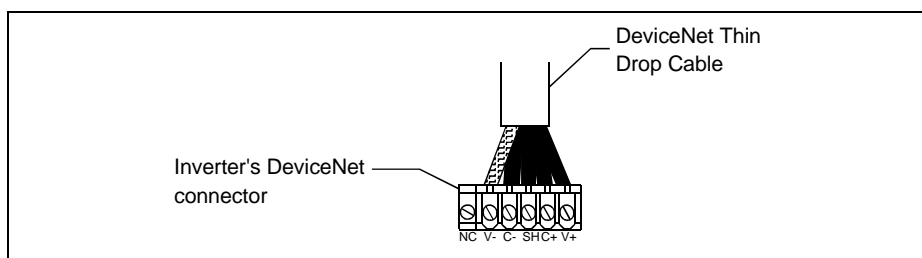
To prevent the cable from being disconnected, terminate the cable gently.

- 3) Connect the drop cable to the DeviceNet connector of the inverter as described below.
  - (a) Insert a flat-blade screwdriver (max. width 3.75mm) into the upper hole of the connector plug and open the clamp in the lower hole to allow the wire to be inserted.
  - (b) When connecting the DeviceNet drop cable, insert the signal, wire and drain wires into the corresponding connector holes and tighten the fastening screws to the corresponding torques. Also, make sure that the colors of the wires are as indicated in the table on the next page.

Recommended tightening torque: 0.22N·m to 0.25N·m



The DeviceNet connector pin out connections are shown in figure below. Refer to the following table for the pin functions.



Connector Pin Out diagram

<b>Pin Out/Functions</b>			
<b>Pin No.</b>	<b>Color</b>	<b>Name</b>	<b>Signal Type</b>
1	Red	V+	Power cable positive end (V+)
2	White	CAN+	Communication data high side (CAN H)
3	Bare	SHLD	Drain
4	Blue	CAN-	Communication data low side (CAN L)
5	Black	V-	Power cable negative end (V-)
6	—	—	—

DeviceNet has a voltage specification of 24VDC for communication and an input voltage specification of 11VDC to 25VDC for communication to each device. A 5V drop in the system is stipulated for each power supply wire (V+, V-).

Note: Use only pins 1 to 5.

The DeviceNet connector of the inverter has a 6-pin socket, but do not connect 6 pins.

**(3) Connection to a Network**

At this point, the inverter must have been installed correctly with the inverter's node address set (refer to page 47 for node address setting), and the DeviceNet cable connected to the inverter.

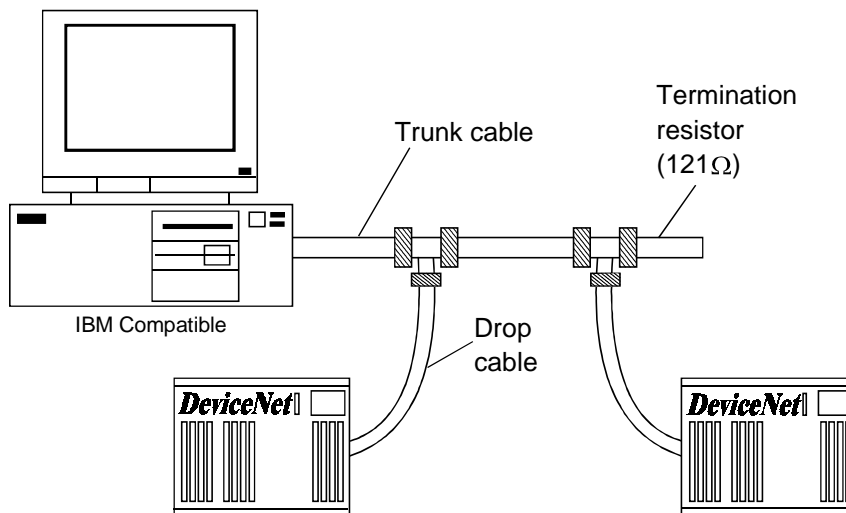
**CAUTION**

Do not connect cable to the network until told to do so. To successfully connect to a DeviceNet network please follow the below procedures and checks:

- 1) Check that the inverter power is turned off.
- 2) Make sure that a terminating resistor is installed at each end of the trunk cable (across CAN(+) and CAN (-)), as shown in the following figure.

These resistors must meet the following requirements:

1.  $R = 121\Omega$
2. 1% metal film
3. 0.25W



Connection to a DeviceNet network

- 3) Connect cable to network as follows (this is the cable from the inverter to the DeviceNet network):

- (a) If the trunk connector is a DeviceNet sanctioned pluggable or sealed connector, the connection to the active network can be made at any time whether the inverter is on or off. The inverter unit automatically detects when the connection is completed.
- (b) If connecting to the network with free wires, power to the network and inverter should be shut off as a safety precaution in case two or more signal wires are accidentally shorted together.

- 4) Check that all connections are completed, and all necessary wires not associated with DeviceNet are connected to the inverter unit as required by the application.

**(4) LED Status Indicator**

The LED Status indicator provides information on the status of operation of the inverter. The status information is shown in the below table. The indicator has five states; Off, Blinking Green, Steady Green, Blinking Red, and Steady Red.

After connecting the drop cable to the trunk of the active network, observe the condition of the Status LED. The inverter unit uses the Combined Module/Network status LED scheme described in the DeviceNet communications standard.

LED Status indication

LED CONDITION	STATE OF SYSTEM	NOTE
Off	Inverter power off Network power on	Turn the inverter power on. The inverter will then complete duplicate node address test.
	Power on the inverter when network Power is off.	Turn the network power on. The inverter unit will then complete duplicate node address test.
Blinking Green	Connection not yet established by master	Though the inverter power is on and it has been confirmed that there is no same node address, the master has not yet established a communication link.
Steady Green	Network and inverter power on, connection established by master	A master device on the network has designated the inverter unit for communications. The LED also holds this state during communication.
Blinking Red	Connection time-out	The master station has selected this inverter unit for communication (LED is green). However, no response is given within the waiting time (Note) set in EPR. Check the master for disconnection from the network.
Steady Red	Critical link failure	Failed communication device <ul style="list-style-type: none"> <li>• Duplicate station number</li> <li>• Network power off</li> <li>• Cable from option unit to network not connected or severed.</li> <li>• Inverter unit is only node on network</li> <li>• Network damaged</li> </ul> Must cycle power to recover from this fault.

Note: Time Limit = 4 × EPR (EXPECTED PACKET RATE)

It should be noted that this EPR is the EPR set by the DeviceNet master. This does not refer to the bit setting of EPR in Pr. 347.

## 2.2.5 Connection to the PU connector

### (1) When connecting the parameter unit using a cable

Use the option FR-CB2□ or the following connector and commercially available cable:

#### <Connection cable>

- Connector : RJ45 connector  
Exempl: 5-554720-3, Tyco Electronics Corporation
- Cable : Cable conforming to EIA568 (e.g. 10BASE-T cable)  
Example: SGLPEV 0.5mm×4P (Twisted pair cable, 4 pairs),  
MITSUBISHI CABLE INDUSTRIES, LTD.

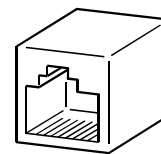
#### <Maximum wiring length>

- Parameter unit (FR-PU04): 20m

### (2) For RS-485 communication

With the accessory cover disconnected, the PU connector can be used for communication operation from a personal computer etc.

When the PU connector is connected with a personal, FA or other computer by a communication cable, a user program allows the inverter to be run and monitored and the parameter values to be read and written.



8) to 1)

- |        |        |
|--------|--------|
| 1) SG  | 5) SDA |
| 2) P5S | 6) RDB |
| 3) RDA | 7) SG  |
| 4) SDB | 8) P5S |

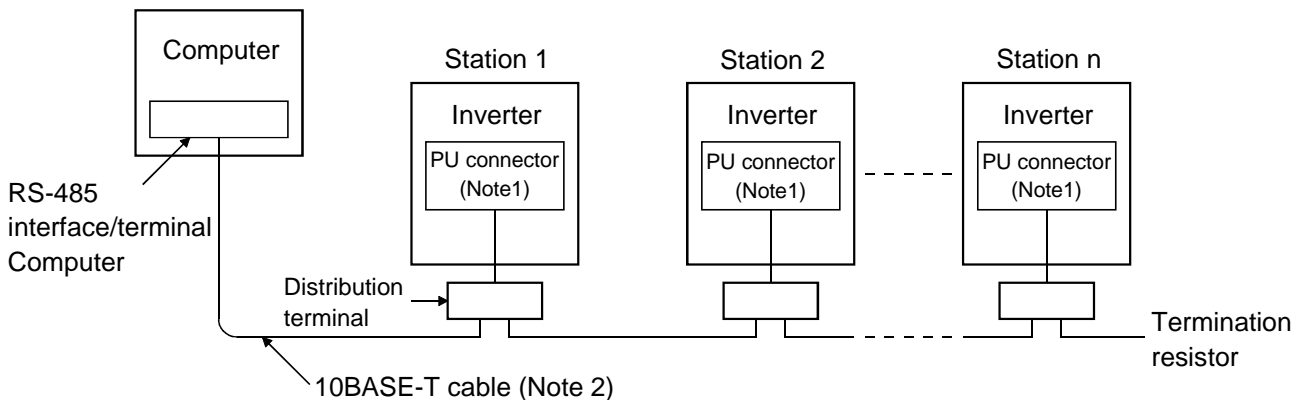
#### <PU connector pin-outs>

Viewed from the inverter (receptacle side) front

- Note: 1. Do not connect the PU connector to a computer's LAN board, FAX modem socket or telephone modular connector. Otherwise, the product may be damaged due to electrical specification differences.
2. Pins 2) and 8) (P5S) provide power to the parameter unit. Do not use these pins for RS-485 communication.

**<System configuration examples>**

1) When a computer having a RS-485 interface is used with several inverters



Use the connectors and cables which are available on the market.

Note: 1. Connector: RJ45 connector

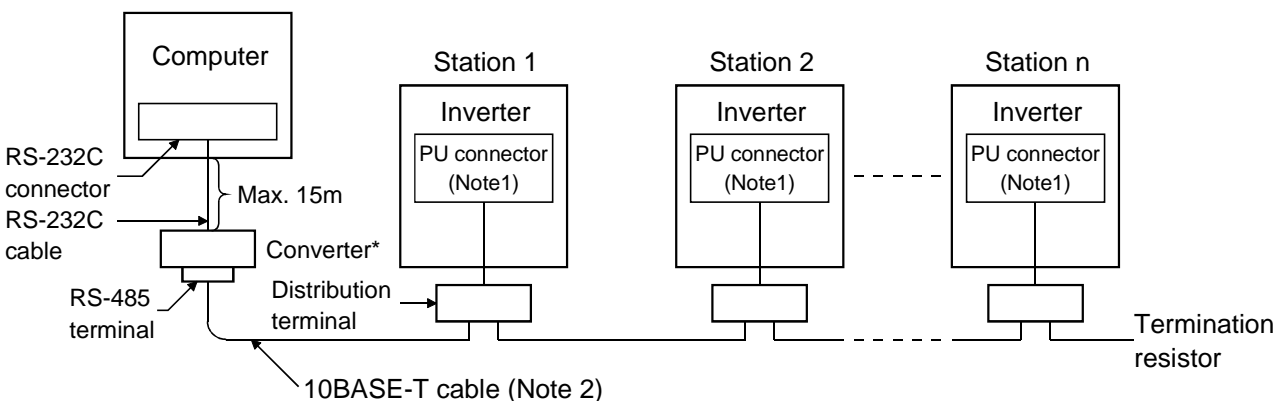
Example: 5-554720-3, Tyco Electronics Corporation

2. Cable : Cable conforming to EIA568 (such as 10BASE-T cable)

Example: SGLPEV 0.5mm × 4P (Twisted pair cable, 4 pairs),  
Mitsubishi Cable Industries, Ltd.

(Do not use pins 2) and 8) (P5S).)

2) When a computer having a RS-232C interface is used with inverters



\*Commercially available converter is required. (Note 3)

Use the connectors, cables and converter which are available on the market.

Note: 1. Connector: RJ45 connector

Example: 5-554720-3, Tyco Electronics Corporation

2. Cable : Cable conforming to EIA568 (such as 10BASE-T cable)

Example: SGLPEV 0.5mm × 4P (Twisted pair cable, 4 pairs),  
Mitsubishi Cable Industries, Ltd.  
(Do not use pins 2) and 8) (P5S).)

3.\*Commercially available converter examples

Model: FA-T-RS40

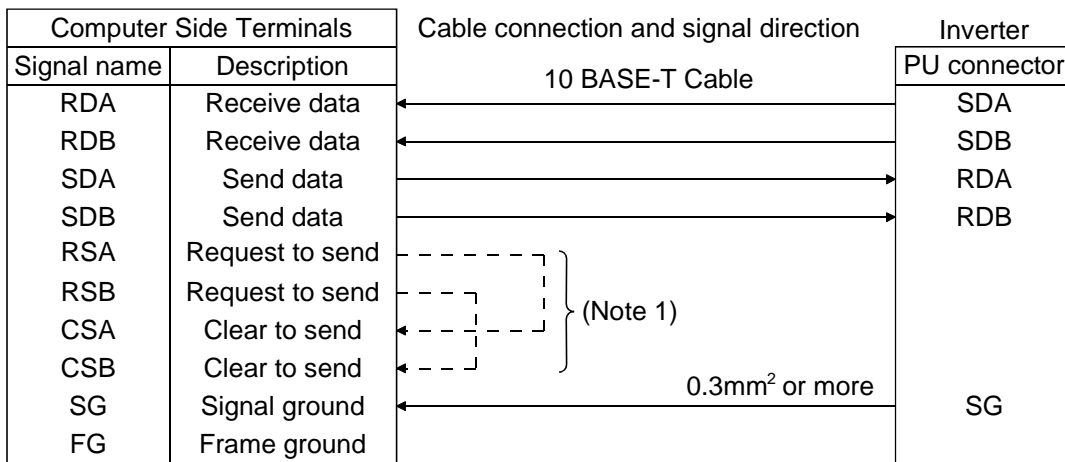
Converter

Mitsubishi Electric Engineering Co., Ltd.

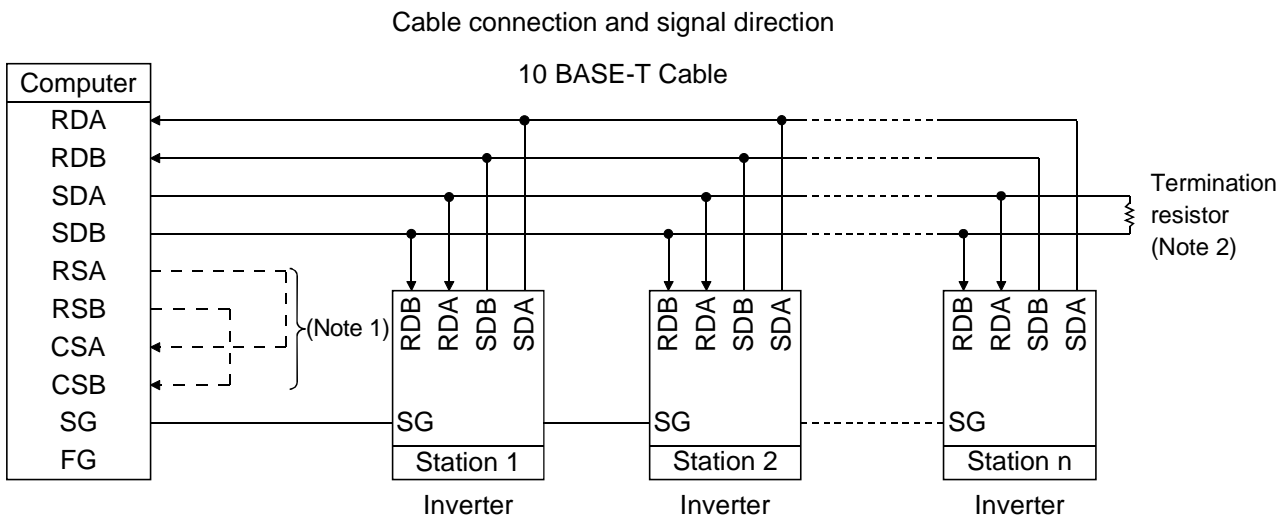


**<Wiring methods>**

1) Wiring of one RS-485 computer and one inverter



2) Wiring of one RS-485 computer and "n" inverters (several inverters)



Note: 1. Make connections in accordance with the instruction manual of the computer used. Fully check the terminal numbers of the computer as they differ between models.

2. There may be the influence of reflection depending on the transmission speed and/or transmission distance. If this reflection hinders communication, provide a termination resistor. If the PU connector is used to make a connection, use the distributor as a termination resistor cannot be fitted. Connect the termination resistor to only the inverter remotest from the computer. (Termination resistor: 100Ω)

## 2.2.6 Connection of stand-alone option units

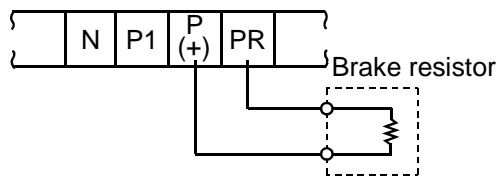
The inverter accepts a variety of stand-alone option units as required. Incorrect connection will cause inverter damage or an accident. Connect and operate the option unit carefully in accordance with the corresponding option unit manual.

### **(1) Connection of the dedicated external brake resistor (option)** **(Cannot be connected to 0.1K and 0.2K)**

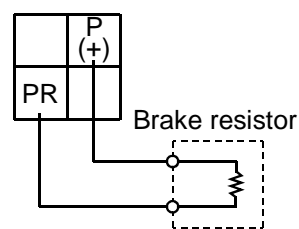
Connect a brake resistor across terminals P (+) and PR. Connect a dedicated brake resistor only.

(For the positions of terminals P (+) and PR, refer to the terminal block layout (page 16).)

•FR-E520-0.4KND, 0.75KND, 5.5KND, 7.5KND

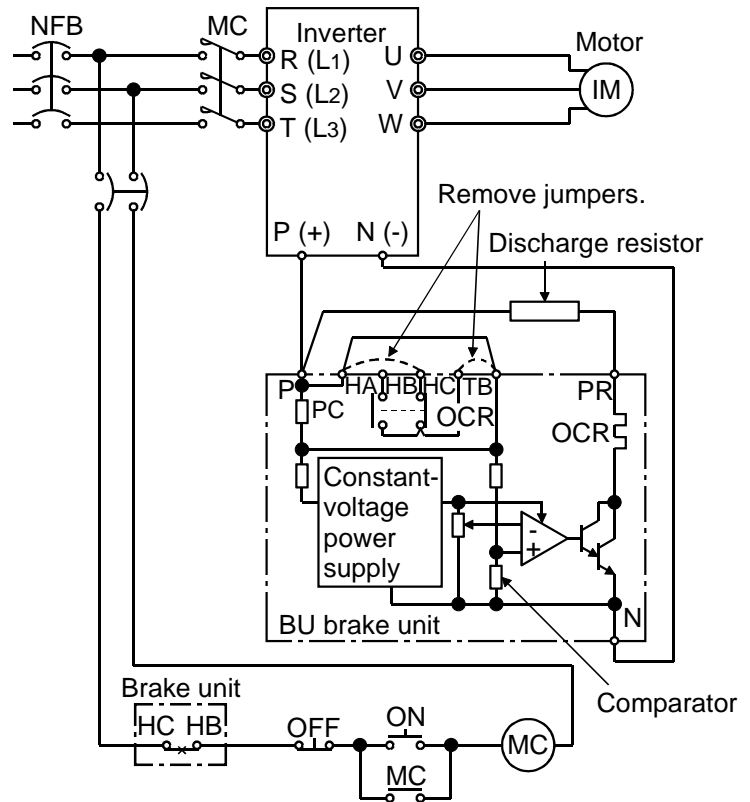


•FR-E520-1.5KND to 3.7KND



**(2) Connection of the BU brake unit (option)**

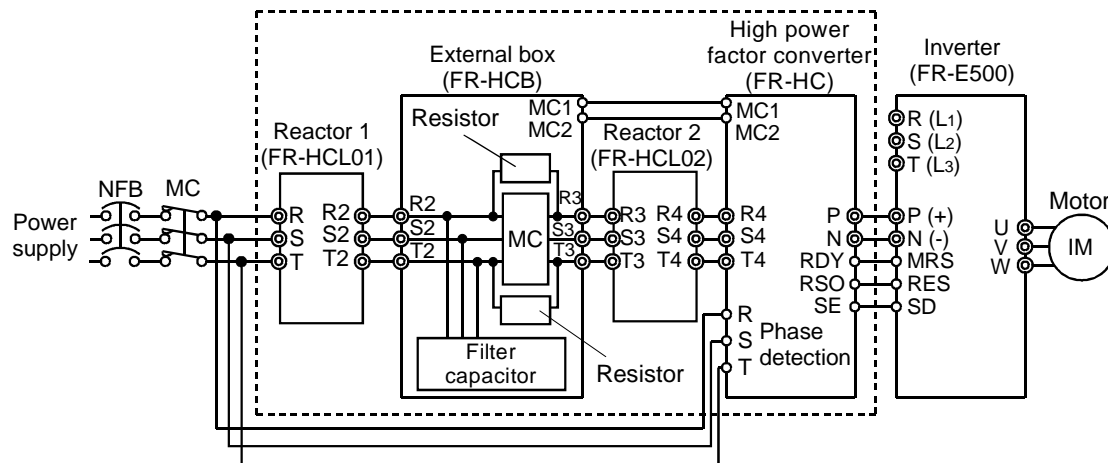
Connect the BU brake unit correctly as shown on the right. Incorrect connection will damage the inverter.



- Note: 1. The wiring distance between the inverter, brake unit and discharge resistor should be within 2m. If twisted wires are used, the distance should be within 5m.
2. If the transistors in the brake unit should fail, the resistor will be extremely hot, causing a fire. Therefore, install a magnetic contactor on the inverter's power supply side to shut off current in case of failure.

### (3) Connection of the FR-HC high power factor converter (option unit)

When connecting the high power factor converter (FR-HC) to suppress power harmonics, wire as shown below. Wrong connection will damage the high power factor converter and inverter.



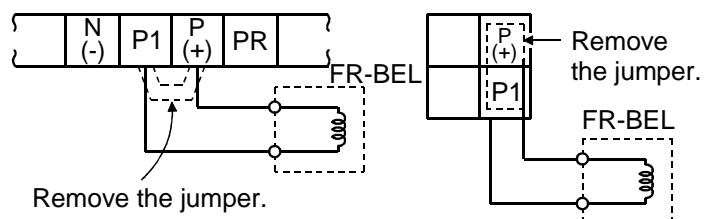
- Note: 1. The power input terminals R, S, T (L1, L2, L3) must be open. Incorrect connection will damage the inverter. Reverse polarity of terminals N (-), P (+) will damage the inverter.
2. The voltage phases of terminals R, S, T (L1, L2, L3) and terminals R4, S4, T4 must be matched before connection.
3. If the load capacity is less than half of the high power factor converter capacity, satisfactory harmonic suppression effects cannot be produced.

### (4) Connection of the power factor improving DC reactor (option)

Connect the FR-BEL power factor improving DC reactor between terminals P1-P (+). In this case, the jumper connected across terminals P1-P (+) must be removed. Otherwise, the reactor will not function.

<Connection method>

- FR-E520-0.1KND to 0.75KND, 5.5KND, 7.5KND
- FR-E520-1.5KND to 3.7KND



- Note: 1. The wiring distance should be within 5m.
2. The size of the cables used should be equal to or larger than that of the power supply cables (R (L1), S (L2), T (L3)).

## 2.2.7 Design information

1) Provide electrical and mechanical interlocks for MC1 and MC2 which are used for commercial power supply-inverter switch-over.

When there is a commercial power supply-inverter switch-over circuit as shown below, the inverter will be damaged by leakage current from the power supply due to arcs generated at the time of switch-over or chattering caused by a sequence error.

2) If the machine must not be restarted when power is restored after a power failure, provide a magnetic contactor in the inverter's primary circuit and also make up a sequence which will not switch on the start signal.

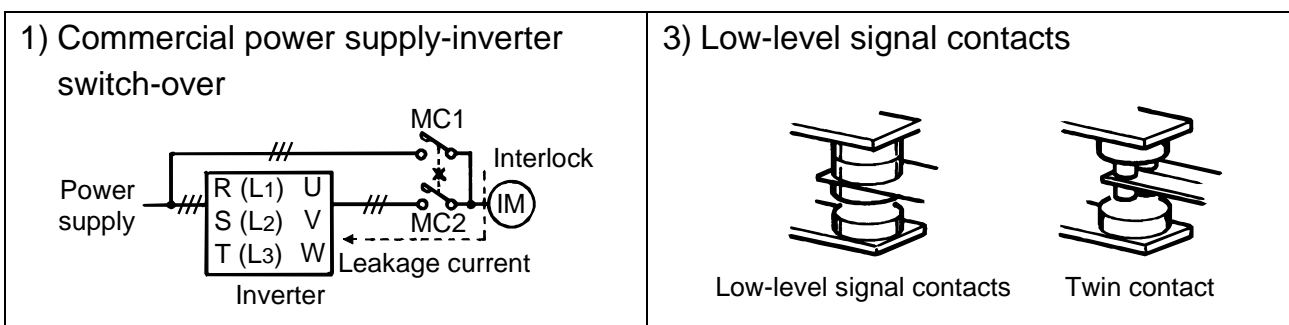
If the start signal (start switch) remains on after a power failure, the inverter will automatically restart as soon as the power is restored.

3) Since the input signals to the control circuit are on a low level, use two or more parallel micro signal contacts or a twin contact for contact inputs to prevent a contact fault.

4) Do not apply a large voltage to the contact input terminals (e.g. STF) of the control circuit.

5) Always apply a voltage to the alarm output terminals (A, B, C) via a relay coil, lamp etc.

6) Make sure that the specifications and rating match the system requirements.



## 2.3 Other Wiring

### 2.3.1 Power supply harmonics

Power supply harmonics may be generated from the converter section of the inverter, affecting the power supply equipment, power capacitor, etc. Power supply harmonics are different in generation source, frequency band and transmission path from radio frequency (RF) noise and leakage currents. Take the following counter measures.

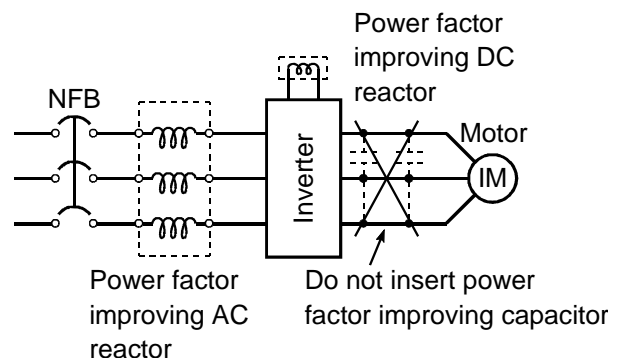
- The differences between harmonics and RF noises are indicated below:

Item	Harmonics	RF Noise
Frequency	Normally 40th to 50th degrees or less, (up to 3kHz or less)	High frequency (several 10kHz to MHz order)
Environment	To wire paths, power impedance	Across spaces, distance, laying paths
Quantitative understanding	Logical computation is possible	Occurs randomly, quantitative understanding is difficult.
Generated amount	Approximately proportional to load capacity	According to current fluctuation rate (larger with faster switching)
Immunity of affected device	Specified in standards for each device.	Differs according to maker's device specifications.
Examples of safeguard	Install a reactor.	Increase the distance.

- Countermeasures

The harmonic current generated from the inverter to the power supply differs according to various conditions such as the wiring impedance, whether a power factor improving reactor is used or not, and output frequency and output current on load side.

For the output frequency and output current, the adequate method is to obtain them under rated load at the maximum operating frequency.



**Note:** A power factor improving capacitor and surge suppressor on the inverter's output side may overheat or be damaged due to the harmonics of the inverter output. Also, when an overcurrent flows in the inverter, the overcurrent protection is activated. Hence, when the motor is driven by the inverter, do not install a capacitor or surge suppressor on the inverter's output side. To improve the power factor, insert a power factor improving reactor in the inverter's input or DC circuit. For details, refer to the FR-A500/E500 series technical information.

### 2.3.2 Japanese harmonic suppression guideline

Harmonic currents flow from the inverter to a power receiving point via a power transformer. The harmonic suppression guideline was established to protect other consumers from these outgoing harmonic currents.

1) "Harmonic suppression guideline for household appliances and general-purpose products"

The "harmonic suppression guideline for household appliances and general-purpose products" issued by ex-Ministry of International Trade and Industry (present Ministry of Economy, Trade and Industry) in September, 1994 applies to the 3.7K and less models. By installing the FR-BEL or FR-BAL power factor improving reactor, inverters comply with the "haramonic suppression techniques for transistorized inverters (input current 20A or less)" established by the Japan Electrical Manufacturers' Association. Therefore, install the optional reactor for the 3.7kW or less inverter.

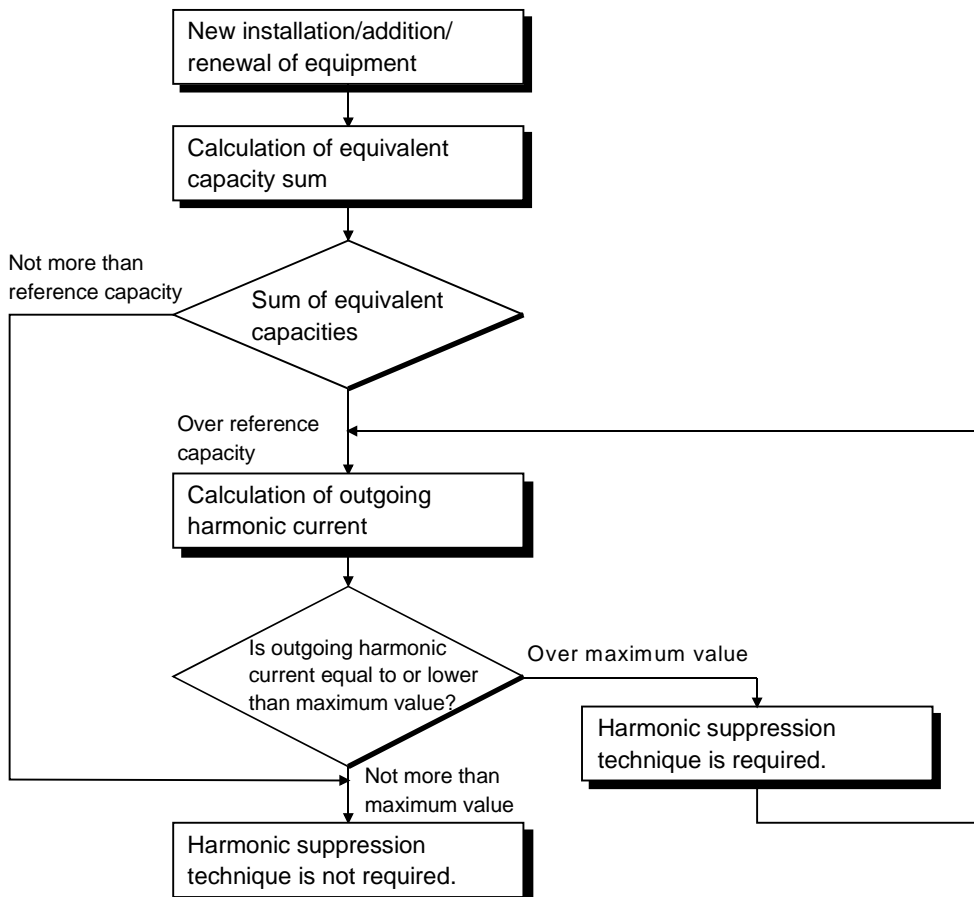
2) "Harmonic suppression guideline for specific consumers"

This guideline sets forth the maximum values of harmonic currents outgoing from a high-voltage or specially high-voltage consumer who will install, add or renew harmonic generating equipment. If any of the maximum values is exceeded, this guideline requires that consumer to take certain suppression measures.

**Table 1 Maximum Values of Outgoing Harmonic Currents per 1kW Contract Power**

Received Power Voltage	5th	7th	11th	13th	17th	19th	23rd	Over 23rd
6.6kV	3.5	2.5	1.6	1.3	1.0	0.9	0.76	0.70
22 kV	1.8	1.3	0.82	0.69	0.53	0.47	0.39	0.36
33 kV	1.2	0.86	0.55	0.46	0.35	0.32	0.26	0.24

**(1) Application of the harmonic suppression guideline for specific consumers**



**Table 2 Conversion Factors for FR-E500 Series**

Class	Circuit Type		Conversion Factor (Ki)
3	3-phase bridge (Capacitor-smoothed)	Without reactor	K31 = 3.4
		With reactor (AC side)	K32 = 1.8
		With reactor (DC side)	K33 = 1.8
		With reactors (AC, DC sides)	K34 = 1.4
5	Self-exciting 3-phase bridge	When high power factor converter is used	K5 = 0

**Table 3 Equivalent Capacity Limits**

Received Power Voltage	Reference Capacity
6.6kV	50 kVA
22/33 kV	300 kVA
66kV or more	2000 kVA

**Table 4 Harmonic Contents (Values at the fundamental current of 100%)**

Reactor	5th	7th	11th	13th	17th	19th	23rd	25th
Not used	65	41	8.5	7.7	4.3	3.1	2.6	1.8
Used (AC side)	38	14.5	7.4	3.4	3.2	1.9	1.7	1.3
Used (DC side)	30	13	8.4	5.0	4.7	3.2	3.0	2.2
Used (AC, DC sides)	28	9.1	7.2	4.1	3.2	2.4	1.6	1.4

1) Calculation of equivalent capacity (P0) of harmonic generating equipment

The "equivalent capacity" is the capacity of a 6-pulse converter converted from the capacity of consumer's harmonic generating equipment and is calculated with the following equation. If the sum of equivalent capacities is higher than the limit in Table 3, harmonics must be calculated with the following procedure:

$$P_0 = \sum (K_i \times P_i) \text{ [kVA]}$$

- Ki : Conversion factor (refer to Table 2)
- Pi : Rated capacity of harmonic generating equipment\* [kVA]
- i : Number indicating the conversion circuit type

\*Rated capacity: Determined by the capacity of the applied motor and found in Table 5. It should be noted that the rated capacity used here is used to calculate a generated harmonic amount and is different from the power supply capacity required for actual inverter drive.

2) Calculation of outgoing harmonic current

Outgoing harmonic current = fundamental wave current (value converted from received power voltage) × operation ratio × harmonic content

- Operation ratio: Operation ratio = actual load factor × operation time ratio during 30 minutes
- Harmonic content: Found in Table 4.



**Table 5 Rated Capacities and Outgoing Harmonic Currents for Inverter Drive**

Applied Motor (kW)	Rated Current [A]	6.6kV Equivalent of Fundamental Wave Current (mA)	Rated Capacity (kVA)	Fundamental Wave Current Converted from 6.6kV (No reactor, 100% operation ratio)							
	200V			5th	7th	11th	13th	17th	19th	23rd	25th
0.4	1.61 (Note)	49	0.57	31.85	20.09	4.165	3.773	2.107	1.519	1.274	0.882
0.75	2.74 (Note)	83	0.97	53.95	34.03	7.055	6.391	3.569	2.573	2.158	1.494
1.5	5.50 (Note)	167	1.95	108.6	68.47	14.20	12.86	7.181	5.177	4.342	3.006
2.2	7.93 (Note)	240	2.81	156.0	98.40	20.40	18.48	10.32	7.440	6.240	4.320
3.7	13.0 (Note)	394	4.61	257.1	161.5	33.49	30.34	16.94	12.21	10.24	7.092
5.5	19.1	579	6.77	376.1	237.4	49.22	44.58	24.90	17.95	15.05	10.42
7.5	25.6	776	9.07	504.4	318.2	65.96	59.75	33.37	24.06	20.18	13.97

Note: When a motor of 3.7kW or less capacity is driven by a transistorized inverter of more than 3.7kW. For example, when a 3.7kW or less motor is driven by a 5.5kW transistorized inverter, the transistorized inverter is not the target of the household appliances/general-purpose products guideline, but because they must be included in the calculation of the harmonic current of the guideline, the fundamental wave input currents are indicated.

3) Harmonic suppression technique requirement

If the outgoing harmonic current is higher than; maximum value per 1kW (contract power) × contract power, a harmonic suppression technique is required.

4) Harmonic suppression techniques

No.	Item	Description
1	Reactor installation (ACL, DCL)	Install a reactor (ACL) in the AC side of the inverter or a reactor (DCL) in its DC side or both to suppress outgoing harmonic currents.
2	High power factor converter (FR-HC)	The converter circuit is switched on-off to convert an input current waveform into a sine wave, suppressing harmonic currents substantially. The high power factor converter (FR-HC) is used with the standard accessory.
3	Installation of power factor improving capacitor	When used with a series reactor, the power factor improving capacitor has an effect of absorbing harmonic currents.
4	Transformer multi-phase operation	Use two transformers with a phase angle difference of 30° as in $\Delta$ - $\Delta$ , $\Delta$ - $\Delta$ combination to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents.
5	AC filter	A capacitor and a reactor are used together to reduce impedances at specific frequencies, producing a great effect of absorbing harmonic currents.
6	Passive filter (Active filter)	This filter detects the current of a circuit generating a harmonic current and generates a harmonic current equivalent to a difference between that current and a fundamental wave current to suppress a harmonic current at a detection point, providing a great effect of absorbing harmonic currents.

### **2.3.3 Inverter-generated noise and reduction techniques**

Some noises enter the inverter causing it to incorrectly operate, and others are radiated by the inverter causing misoperation of peripheral devices. Though the inverter is designed to be insusceptible to noise, it handles low-level signals, so it requires the following basic measures to be taken. Also, since the inverter chops the output at high carrier frequencies, it could generate noise. If these noises cause peripheral devices to misoperate, measures should be taken to suppress noise. The measures differ slightly depending on noise propagation paths.

#### 1) Basic measures

- Do not run the power cables (I/O cables) and signal cables of the inverter in parallel with each other and do not bundle them.
- Use twisted shield cables for the detector connecting and control signal cables and connect the sheathes of the shield cables to terminal SD.
- Ground the inverter, motor, etc. at one point.

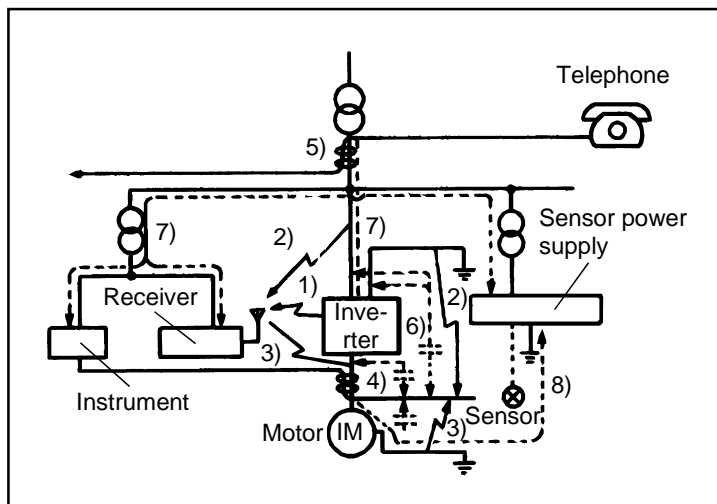
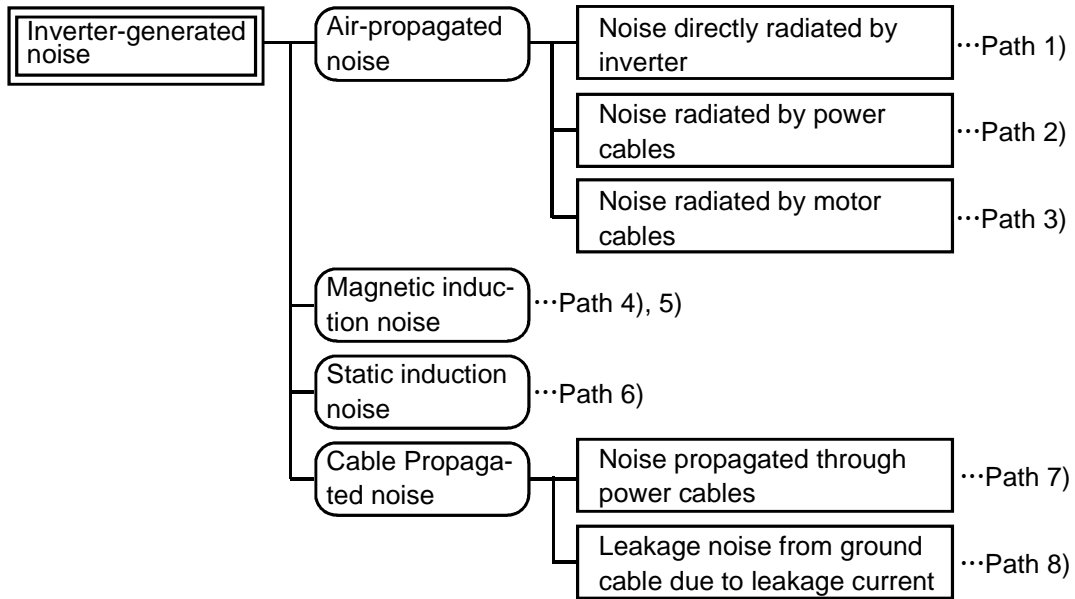
#### 2) Measures against noise which enters and causes misoperation of the inverter

When devices which generate noise (devices which use magnetic contactors, magnetic brakes, many relays, for example) are installed near the inverter, the inverter may misoperate due to noise. The following measures must be taken:

- Provide surge suppressors for devices that generate noise to suppress noise.
- Fit data line filters (refer to page 40) to signal cables.
- Ground the shields of the detector connection and control signal cables with cable clamp metal.

3) Measures against noises which are radiated by the inverter causing misoperation of peripheral devices.

Inverter-generated noises are largely classified into those radiated by the cables connected to the inverter and inverter main circuit (I/O), those electromagnetically and electrostatically inducted to the signal cables of the peripheral devices close to the main circuit power supply, and those transmitted through the power supply cables.

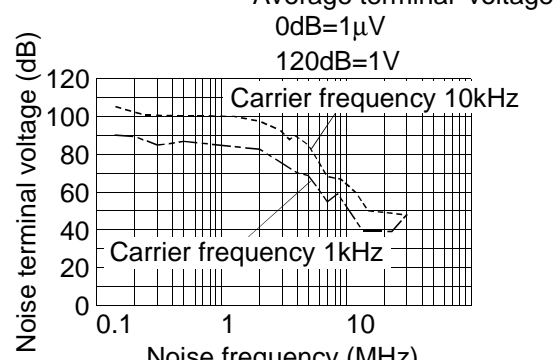
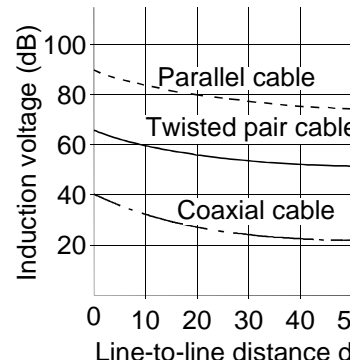


Noise Path	Measures
1), 2), 3)	<p>When devices which handle low-level signals and are susceptible to misoperation due to noise (such as instruments, receivers and sensors) are installed near the inverter and their signal cables are contained in the same panel as the inverter or are run near the inverter, the devices may be misoperated by air-propagated noise and the following measures must be taken:</p> <ol style="list-style-type: none"> <li>(1) Install easily affected devices as far away as possible from the inverter.</li> <li>(2) Run easily affected signal cables as far away as possible from the inverter.</li> <li>(3) Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them.</li> <li>(4) Insert line noise filters onto I/O and radio noise filters into inputs to suppress cable-radiated noises.</li> <li>(5) Use shielded cables for signal cables and power cables and run them in individual metal conduits to further reduce effects.</li> </ol>
4), 5), 6)	<p>When the signal cables are run in parallel with or bundled with the power cables, magnetic and static induction noises may be propagated to the signal cables causing misoperation of the devices and the following measures must be taken:</p> <ol style="list-style-type: none"> <li>(1) Install easily affected devices as far away as possible from the inverter.</li> <li>(2) Run easily affected signal cables as far away as possible from the inverter.</li> <li>(3) Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them.</li> <li>(4) Use shielded cables for signal cables and power cables and run them in individual metal conduits to further reduce effects.</li> </ol>
7)	<p>When the power supplies of the peripheral devices are connected to the power supply of the inverter within the same line, inverter-generated noise may flow back through the power supply cables causing misoperation of the devices and the following measures must be taken:</p> <ol style="list-style-type: none"> <li>(1) Install the radio noise filter (FR-BIF) to the power cables (input cables) of the inverter.</li> <li>(2) Install the line noise filter (FR-BLF, FR-BSF01) to the power cables (I/O cables) of the inverter.</li> </ol>
8)	<p>When a closed loop circuit is formed by connecting the peripheral device wiring to the inverter, leakage current may flow through the ground cable of the inverter causing misoperation of the device. In such a case, disconnection of the ground cable of the device may cause the device to operate properly.</p>

● **Data line filter**

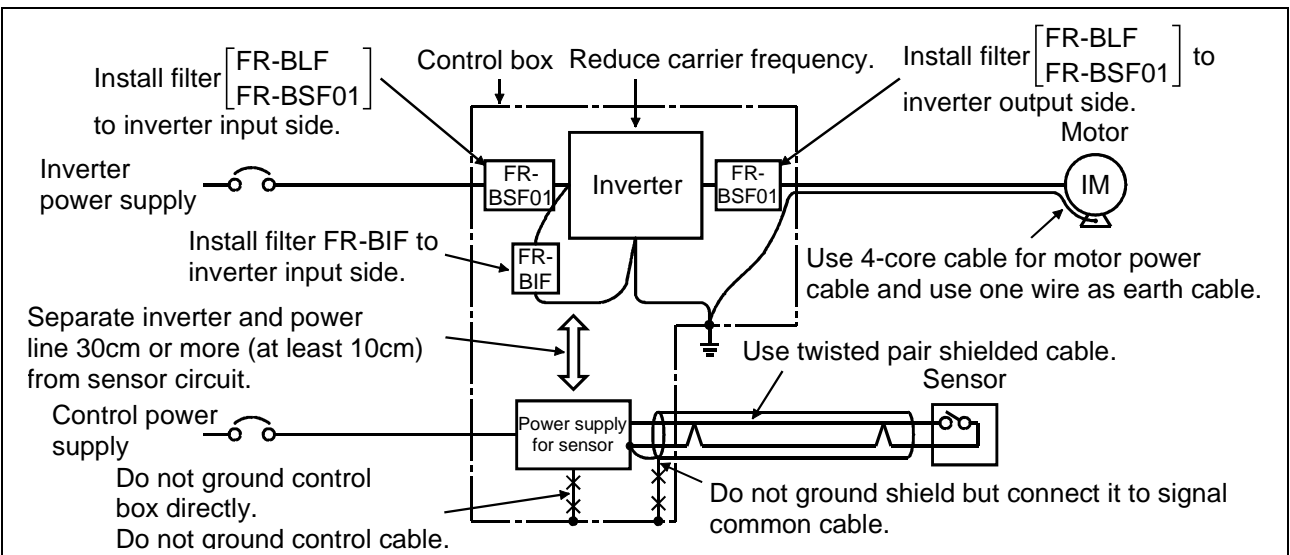
Noise entry can be prevented by providing a data line filter for the detector or other cable.

● **Data examples**

<p>By decreasing the carrier frequency, the noise terminal voltage* can be reduced. Use Pr. 72 to set the carrier frequency to a low value (1kHz). Though motor noise increases at a low carrier frequency, selection of Soft-PWM will make it unoffending.</p>	<p>By using shielded cables as signal cables, induction noise can be reduced greatly (1/10 to 1/100). Induction noise can also be reduced by moving the signal cables away from the inverter output cables. (Separation of 30cm reduces noise to 1/2 to 1/3.) By fitting the FR-BSF01 or BLF on the inverter output side, induction noise to the signal cables can be reduced.</p>
<p>Differences between noise terminal voltages at different carrier frequencies</p> <p>Conditions Average terminal voltage 0dB=1μV 120dB=1V</p>  <p>Noise terminal voltage (dB)</p> <p>Noise frequency (MHz)</p> <p>Carrier frequency 10kHz</p> <p>Carrier frequency 1kHz</p>	<p>Noise induced to signal cables by inverter output cables</p>  <p>Induction voltage (dB)</p> <p>Line-to-line distance d (cm)</p> <p>Conditions Inverter: FR-E520-3.7K Motor: FR-JR 4P 3.7kW Output frequency: 30Hz Noise form: Normal mode</p> <p>Parallel cable</p> <p>Twisted pair cable</p> <p>Coaxial cable</p> <p>Inverter</p> <p>FR-BLF</p> <p>FR-BSF01 (4T)</p> <p>Motor</p> <p>Terminal</p> <p>Measuring instrument</p> <p>5cm</p> <p>d(cm)</p>

\* Noise terminal voltage: Represents the magnitude of noise propagated from the inverter to the power supply.

● **Example of counter measures against noise**



### 2.3.4 Leakage currents and countermeasures

Due to the static capacitance existing in the inverter I/O wiring and motor, leakage currents flow through them. Since their values depend on the static capacitance, carrier frequency, etc., take the following measures.

#### (1) To-ground leakage currents

Leakage currents may flow not only into the inverter's own line but also into the other lines through the ground cable, etc. These leakage currents may operate earth leakage circuit breakers and earth leakage relays unnecessarily.

##### ● Countermeasures

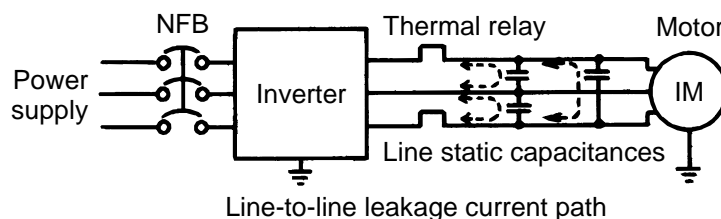
- If the carrier frequency setting is high, decrease the carrier frequency (Pr. 72) of the inverter.  
Note that motor noise increases. Selection of Soft-PWM (Pr. 240) will make it unoffending.
- By using earth leakage circuit breakers designed for harmonic and surge suppression (e.g. Mitsubishi's Progressive Super Series) in the inverter's own line and other line, operation can be performed with the carrier frequency kept high (with low noise).

##### ● To-ground leakage current

- Note that a long wiring length will increase leakage currents. Decrease the carrier frequency of the inverter to reduce leakage currents.
- Higher motor capacity leads to larger leakage currents.

#### (2) Line-to-line leakage currents

Harmonics of leakage currents flowing in static capacities between the inverter output cables may operate the external thermal relay unnecessarily.



##### ● Countermeasures

- Use the electronic overcurrent protection of the inverter.
- Decrease the carrier frequency. Note that motor noise increases. Selection of Soft-PWM will make it unoffending.

To ensure that the motor is protected not to be influenced by line-to-line leakage currents, we recommend the protection method which uses a temperature sensor to directly detect motor temperature.

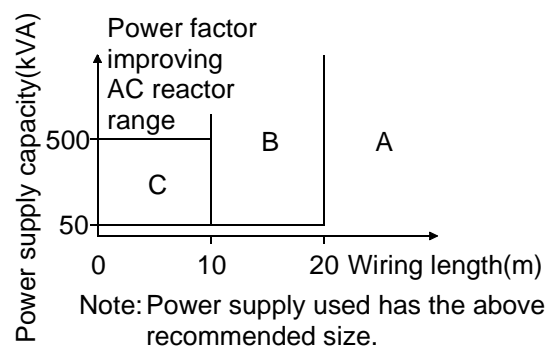
## 2.3.5 Peripheral devices

### (1) Selection of peripheral devices

Check the capacity of the motor to be used with the inverter you purchased. Appropriate peripheral devices must be selected according to the capacity. Refer to the following list and prepare appropriate peripheral devices:

	Inverter Type	Motor Output (kW)	Power Supply Capacity (kVA)	No-Fuse Breaker (NFB) or Earth Leakage Circuit Breaker (NV) (Note 5)		Magnetic Contactor (MC)		
				Standard	With power factor improving reactor	A	B	C
Three-phase 200V	FR-E520-0.1K	0.1	0.4	30AF 5A	30AF 5A	S-N11	S-N18	S-N20
	FR-E520-0.2K	0.2	0.8	30AF 5A	30AF 5A	S-N18	S-N20	S-N20
	FR-E520-0.4K	0.4	1.5	30AF 5A	30AF 5A	S-N18	S-N21	S-N21
	FR-E520-0.75K	0.75	2.5	30AF 10A	30AF 10A	S-N18	S-N21	S-N21
	FR-E520-1.5K	1.5	4.5	30AF 15A	30AF 15A	S-N21	S-N25	S-N50
	FR-E520-2.2K	2.2	5.5	30AF 20A	30AF 15A	S-N11,S-N12		
	FR-E520-3.7K	3.7	9	30AF 30A	30AF 30A	S-N20		
	FR-E520-5.5K	5.5	12	50AF 50A	50AF 40A	S-N25		
FR-E520-7.5K	7.5	17	100AF 60A	50AF 50A	S-N35			

- Note: 1. Select the type of the no-fuse breaker (NFB) in response to the power supply capacity.
2. The power supply cable size of the motor indicated assumes that its length is 20m.
3. The inverter input side magnetic contactor to be chosen differs between the applicable ranges A, B and C shown on the right, depending on the power supply capacity and wiring length. For the FR-E520-0.4KND to 1.5KND choose the S-N10 when the power factor improving reactor (FR-BEL or FR-BAL) is used.
4. When the inverter capacity is greater than the motor capacity, choose the breaker and magnetic contactor in accordance with the inverter type and choose the cables and power factor improving reactor in accordance with the motor output.
5. For installations in the United States or Canada, the circuit breaker must be inverse time or instantaneous trip type.



#### ● Installation and selection of no-fuse breaker

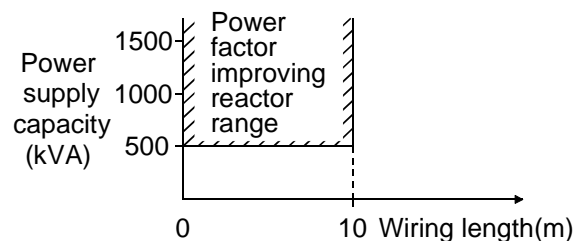
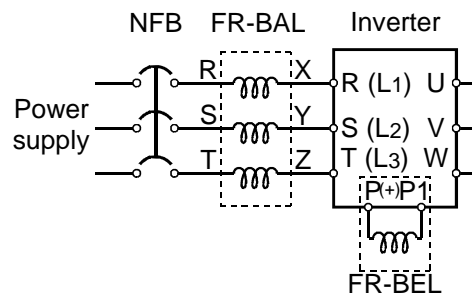
Install a no-fuse breaker (NFB) in the power supply side for protection of the inverter's primary wiring. Refer to the previous table and choose the NFB according to the inverter's power supply side power factor (which changes with the power supply voltage, output frequency and load). Especially for a completely electromagnetic type NFB, the one with a larger capacity must be selected since its operational characteristics change with harmonic currents. (Check the data of the corresponding breaker for confirmation.) Also the earth leakage circuit breaker used should be our product durable against harmonics/surges (such as the Progressive Super Series).

● **Power factor improving reactor**

	<b>Inverter Model</b>	<b>Power Factor Improving AC Reactor</b>	<b>Power Factor Improving DC Reactor</b>
Three-phase 200V	FR-E520-0.1KND	FR-BAL-0.4K (Note)	FR-BEL-0.4K (Note)
	FR-E520-0.2KND	FR-BAL-0.4K (Note)	FR-BEL-0.4K (Note)
	FR-E520-0.4KND	FR-BAL-0.4K	FR-BEL-0.4K
	FR-E520-0.75KND	FR-BAL-0.75K	FR-BEL-0.75K
	FR-E520-1.5KND	FR-BAL-1.5K	FR-BEL-1.5K
	FR-E520-2.2KND	FR-BAL-2.2K	FR-BEL-2.2K
	FR-E520-3.7KND	FR-BAL-3.7K	FR-BEL-3.7K
	FR-E520-5.5KND	FR-BAL-5.5K	FR-BEL-5.5K
	FR-E520-7.5KND	FR-BAL-7.5K	FR-BEL-7.5K

Note: The power factor may be slightly less.

When the inverter is connected near a large-capacity power supply transformer (500kVA or more, wiring length 10m maximum) or there is power capacitor switch-over, excessive peak currents may flow into the power input circuit and damage the converter circuit. In such a case, the power supply improving reactor (FR-BEL or FR-BAL) must be installed.

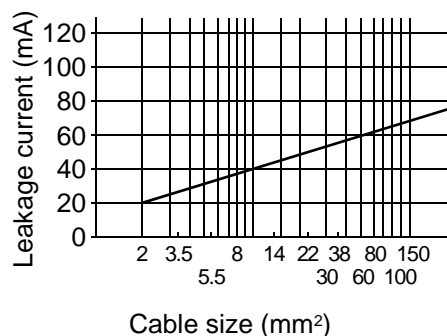




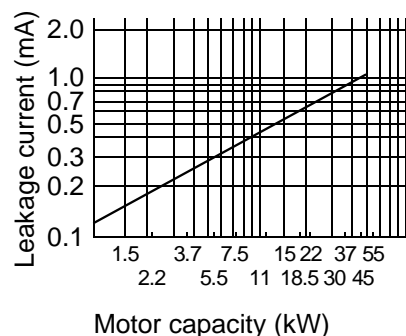
## (2) Selecting the rated sensitivity current for the earth leakage circuit breaker

When using the earth leakage circuit breaker with the inverter circuit, select its rated sensitivity current as follows, independently of the PWM carrier frequency:

Example of leakage current per 1km in cable path during commercial power supply operation when the CV cable is routed in metal conduit (200V 60Hz)



Leakage current example of 3-phase induction motor during commercial power supply operation (200V 60Hz)



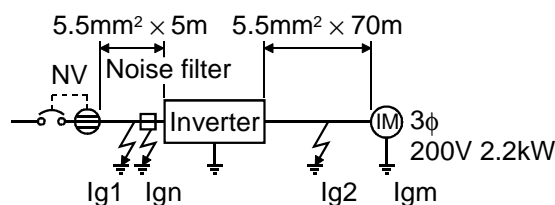
- Progressive Super Series (Type SP, CF, SF, CP)  
Rated sensitivity current:  $I_{\Delta n} \geq 10 \times (I_{g1} + I_{gn} + I_{g2} + I_{gm})$
- Conventional NV series (Type CA, CS, SS produced prior to '91)  
Rated sensitivity current:  $I_{\Delta n} \geq 10 \times \{I_{g1} + I_{gn} + 3 \times (I_{g2} + I_{gm})\}$

$I_{g1}, I_{g2}$  : Leakage currents of cable path during commercial power supply operation

$I_{gn}^*$  : Leakage current of noise filter on inverter input side

$I_{gm}$  : Leakage current of motor during commercial power supply operation

### <Example>



- Note: 1. The earth leakage circuit breaker should be installed to the primary (power supply) side of the inverter.
2. Ground fault in the secondary side of the inverter can be detected at the running frequency of 120Hz or lower.
3. In the  $\Delta$  connection neutral point grounded system, the sensitivity current becomes worse for ground faults in the inverter secondary side. Hence, the protective grounding of the load equipment should be class C grounding ( $10\Omega$  or less).
4. When the breaker is installed in the secondary side of the inverter, it may be unnecessarily operated by harmonics if the effective value is less than the rating. In this case, do not install the breaker since the eddy current and hysteresis loss increase and the temperature rises.
- \* Note the leakage current value of the noise filter installed on the inverter input side.

	<b>Progressive Super Series (Type SP, CF, SF,CP)</b>	<b>Conventional NV (Type CA, CS, SS)</b>
Leakage current (I <sub>g1</sub> ) (mA)	$33 \times \frac{5m}{1000m} = 0.17$	
Leakage current (I <sub>gn</sub> ) (mA)	0 (without noise filter)	
Leakage current (I <sub>g2</sub> ) (mA)	$33 \times \frac{70m}{1000m} = 2.31$	
Motor leakage current (I <sub>gm</sub> ) (mA)	0.18	
Total leakage current (mA)	2.66	7.64
Rated sensitivity current (≥ I <sub>g</sub> × 10) (mA)	30	100

**2.3.6 Instructions for compliance with U.S. and Canadian Electrical Codes**



**(Standard to comply with: UL 508C)**

**(1) Installation**

The above types of inverter have been approved as products for use in enclosure and approval tests were conducted under the following conditions. For enclosure design, refer to these conditions so that the ambient temperature of the inverter is 50°C or less.

Inverter Type	Cabinet (enclosure) Size (Unit: mm)	Vent Hole Area	Cooling Fan
FR-E520 - 3.7KND	W H D 255×192×218	<ul style="list-style-type: none"> <li>• 55% of both the side of the Cabinet</li> <li>• Width of each slit: 3.2mm</li> <li>• To be provided on each of the upper side areas.</li> </ul>	Installed at the enclosure top to suck air from inside the enclosure to the outside. (Fan air flow: 2 × 0.59m <sup>3</sup> /min or more)

**(2) Branch circuit protection**

For installation in United States, branch circuit protection must be provided, in accordance with the National Electrical Code and any applicable local codes. For installation in Canada, branch circuit protection must be provided in accordance with the Canada Electrical Code and any applicable provincial codes.

**(3) Short circuit ratings**

Suitable For Use In A Circuit Capable of Delivering Not More Than 5kA rms Symmetrical Amperes.

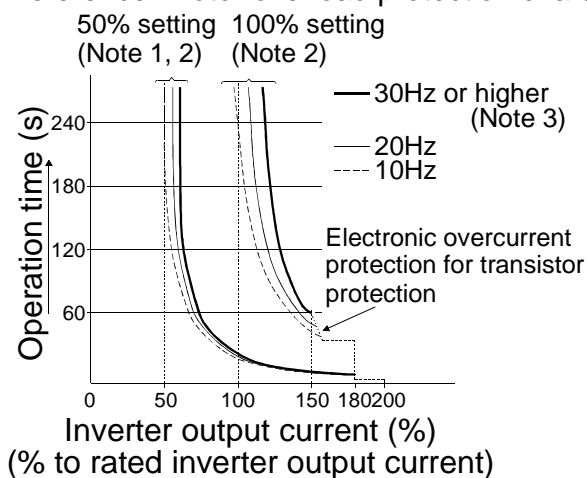
**(4) Wiring of the power supply and motor**

Screw the cables wired to the input (R, S, T) <L1, L2, L3> and output (U, V, W) terminals and control circuit of the inverter to the specified tightening torque using UL-recognized, 75° or higher rated copper wires and round crimping terminals. Crimp the crimping terminals with the crimping tool recommended by the terminal maker.

**(5) Motor overload protection**

When using the electronic overcurrent protection function as motor overload protection, set the rated motor current in Pr. 9 "electronic thermal O/L relay". When connecting two or more motors to the inverter, install external thermal relays for individual motors.

Reference: Motor overload protection characteristics



- Protection activating range  
Range on the right of characteristic curve
- Normal operating range  
Range on the left of characteristic curve

- (Note 1) When you set the 50% value (current value) of the rated inverter output current.
- (Note 2) The % value denotes the percentage of the current value to the rated inverter output current, not to the rated motor current.
- (Note 3) This characteristic curve will be described even under operation of 6Hz or higher when you set the electronic overcurrent protection dedicated to the Mitsubishi constant-torque motor.

# CHAPTER 3

## OPERATION/CONTROL

This chapter provides the basic "operation/control" for use of this product.

Always read this chapter before using the equipment.

3.1 Inverter Settings.....	47
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# 3.1 Inverter Settings

## 3.1.1 Node address of the inverter

### (1) Node address setting

Assign a node address for each device (e.g. FR-E520KND) on the DeviceNet network within the range of 0 to 63. To assign the node address, use the node address setting switches SW1 and SW2 (SW1 corresponds to a tens value and SW2 a units value). For location of the rotary switches refer to page 4.

To set the station number follow the below procedure:

- 1) Make sure that the inverter is powered down and that it is safe to work upon. After ensuring that it is safe, remove the inverter's front cover. (Refer to page 5 for details of front cover removal.) The rotary station number selection switches should be visible in the top right hand side of the terminal connection area.
- 2) Set the node address within the range of 0 to 63 (Note). Any number out of the range of 0 to 63 is automatically changed to 63 by the option unit software.

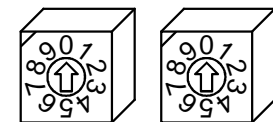
Setting method

- Set the arrows ( $\uparrow$ ) of the corresponding switches to the required node address.

Node address setting switches

Example:

- For node address 1: Set ( $\uparrow$ ) of  $\times 10$  to "0" and ( $\uparrow$ ) of  $\times 1$  to "1".
- For node address 26: Set ( $\uparrow$ ) of  $\times 10$  to "2" and ( $\uparrow$ ) of  $\times 1$  to "6".



SW1 ( $\times 10$ ) SW2 ( $\times 1$ )

- 3) Connect the DeviceNet thin drop cable to the inverter by inserting the 6-pin connector into the DeviceNet standard socket on the inverter. Make sure that the connection is correct as the inverter has a 6-pin socket with one pin (NC) not used.
- 4) Carefully reinstall the inverter's front cover, making sure that the signal wires, etc. do not come off during the replacement of the front cover.

Note: SW1 is the 10 times unit and SW2 is the 1 times unit.

### REMARKS

If there is any duplication of an address for the nodes, a serious link error will occur (red lamp is lit). (Refer to page 138)

If the same node address is found in the network configuration, you can change the setting via the network using DeviceNet, Class 0x03 - Instance 1 - Attribute 1. (Refer to page 158)

## **(2) Changing Node Addresses**

The state of the node address is sampled once at power on. Changing the address later on will have no effect and the software will keep the number read at power on.

The following procedure explains how to change the Node address switches:

- 1) Turn power to the inverter off.
- 2) Remove the inverter cover.
- 3) Disconnect drop cable from inverter unit.
- 4) Set the Node address (rotary switches) as desired.
- 5) Reconnect the drop cable to the inverter unit.
- 6) Reinstall inverter cover.
- 7) Turn inverter power back on.

## 3.2 Configuration

This section is intended to facilitate the configuration of the FR-E500KND inverter with minimum effort. The description assumes that each value is the factory setting value. If the user wishes to change these values, the data necessary to do so is provided later in the manual.

This section also assumes that the network cabling is complete and DeviceNet communication has been established. The LED status of the inverter must be blinking green or steady green as described on page 25.

### 3.2.1 General description

The inverter is regarded as a slave device in the DeviceNet Communication Standard. This means that the inverter cannot start a message on the network. A master device must establish a connection to the inverter unit and then send commands, requests for information, etc. (Note)

Note: When the master station is set-up and turned on, the inverter unit may need up to 1 minute to get set to a ready for communication status.

This is a situation may occur for just the DeviceNet configuration stage, so this should not be a general problem.

The FR-E500KND supports group 3 messaging as defined in the DeviceNet Standard. This feature means that one master can control the inverter while another master is able to read data from the same inverter. This also means that the DeviceNet master must support the UCMM protocol for proper operation.

Note: It is strongly recommended that the user configures the DeviceNet network using a software tool designed specifically for that purpose. The use of such a tool greatly simplifies the configuration, reduces confusion, and enhances accuracy. Additionally, the configuration tool will facilitate the elimination of conflicts between network devices and ensure consistency throughout the network.

One such tool is DeviceNet Manager™ as supplied by Rockwell Automation. Tools are available from many other suppliers but the descriptions contained in the Getting Started section are based upon the use of DeviceNet Manager™.

To use the DeviceNet Manager™ software, you will need to acquire the DeviceNet Electronic Data Sheet (EDS) file. The EDS file is a standard DeviceNet file which defines the configurable parameters of a field device and facilitates the network configuration software's ability to recognize a specific field device. Please refer to the configuration software tool instruction manual for more information about the installation and use of EDS files.

The most recent revision of the FR-E500KND EDS file is available on the Internet as well as a separate item from Mitsubishi Electric.

Refer to page 180 for details on how to get this file.

### 3.2.2 Set baud rate:

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The baud rate must be consistent throughout the network in order to establish communication and allow configuration via the network.

Therefore, this setting is important in the inverter unit configuration.

- Switching power on initializes the FR-E500KND to the communication speed of 125Kbps.
- You can set the baudrate via the network using DeviceNet, Class 0x03 - Instance 1 - Attribute 2. (Refer to page 158)
- By changing the Pr. 346 and Pr. 348 values, you can set the baudrate manually from the parameter unit. (Refer to page 125)

### 3.2.3 Set node address:

---

The node address assigned to the inverter on page 47 establishes the default node address when the inverter is powered on. If the same node address is found in the network configuration, you can change the setting via the network using DeviceNet, Class 0x03 - Instance 1 - Attribute 1. (Refer to page 158)

### 3.2.4 DeviceNet I/O assembly:

---

Communication between a master device and a slave device on the network requires that the DeviceNet Class 0x04 – "Assembly Object" in both devices be the same.

#### **(1) Default I/O assembly:**

When power is switched on, the FR-E500KND is set to Class 0x04 - Output Instance 21 and Class 0x04 - Input Instance 71 as set at the factory. Refer to page 159 for further information on DeviceNet Class 0x04 and changing the desired Output and Input Instances.

#### **(2) Polling rate:**

Determination of the proper polling rate of the DeviceNet master device is dependent upon the characteristics of the entire network. To minimize a collision and maximize system reliability, we recommend that you set the polling rate intervals to be at least 30ms. The user may, at their discretion, adjust this rate as network performance allows.



### **(3) Loss of communications**

In the default polled communication mode, the FR-E500KND will respond to loss of communication based upon the configuration of the EPR bits of Pr. 345 and Pr. 347 as defined on page 125. The default value of these bits is decimal 0. Such loss of polling may occur upon physical disconnection of network cabling, network power loss, failure within the master, etc.

When the EPR bits of Pr. 345 and Pr. 347 are set to decimal 0, the inverter will continue to execute the last command received until the communication time-out is reached. This time out value is equal to 4 times the Expected Packet Rate (Note that this EPR is as set by the DeviceNet master. This is different to the setting of the EPR bits of Pr. 345 and Pr. 347) as configured by the user. When the inverter times out, it will generate an E.OPT error and coasts to a stop.

When the EPR bits of Pr. 345 and Pr. 347 are set to decimal 2, the inverter will continue to execute the last command received until another command is issued. The FR-E520KND inverter will ignore the communication loss, generate no error and automatically reset the connection when communication is restored.

## 3.3 Operation

The operation modes will be explained as follow. Also parameter definitions for specific DeviceNet parameters are described.

### 3.3.1 Operation modes

#### PU operation mode

Control of the inverter is from the parameter unit (PU).

#### DeviceNet operation mode

Control of the inverter is via commands from a DeviceNet master.

#### Operation mode selection

The following conditions must be met before a mode change can be effected:

- Inverter is stopped.
- Forward and reverse commands are off.

### 3.3.2 Functions available in the operation modes

The functions of the inverter depend upon the operation mode. The following chart indicates the available commands according to the inverter operation mode.

Control type	Command type	Operation mode	
		DeviceNet	PU
DeviceNet	Operation command	Yes	No
	Output frequency setting	Yes	No
	Monitor	Yes	Yes
	Parameter write	Yes (Note 2) (while stopped)	No (Note 2)
	Parameter read	Yes	Yes
	Inverter reset	Yes (Note 1)	No
External terminals	Operation command	No	No
	Output frequency setting	No	No
	Inverter reset	Yes	Yes

Note: 1. The inverter cannot be reset if a communication error occurs.

2. As set in Pr. 77

3. When the parameter unit (FR-PU04) is used, the external terminals are used for control of the inverter. The inverter does not have terminals for direct control of operation commands or frequency setting.

### 3.3.3 Input from DeviceNet to inverter

#### Control input commands

The FR-E500KND supports STF and STR. Some other Control Input Commands are supported as well.

#### Output Frequency Setting

Output frequency setting is possible for the range 0 to 400 Hz in increments of 0.01 Hz.

#### Inverter reset

The inverter can be reset via DeviceNet using the Identity Object reset service.

Note that this reset service also performs a parameter clear, the type of which depends upon the type of the Identity Object reset service. (Refer to page 157.)

#### Parameter writing

Refer to page 173 for parameters.

### 3.3.4 Output from inverter to DeviceNet

#### Inverter status

The inverter status can be monitored using class 0x2A, attribute 114, the FR-E500KND inverter status. This is a bitmapped status byte defined as follows:

Bit	Definition	
0	Running	(RUN)
1	Forward running	(FWD)
2	Reverse running	(REV)
3	Up to frequency	(SU)
4	Overload	(OL)
5	—	—
6	Frequency detection	(FU)
7	Alarm	—

#### Inverter monitoring

- Output frequency
- Output current
- Output voltage

#### Parameter read

Refer to page 173 for parameters.

Some inverter parameters require configuration to be viewed via the PU. All supported parameters are fully accessible regardless of inverter configuration in such cases.

### 3.3.5 Operation on alarm occurrence

The following table shows the behavior of the inverter and network communication operation on alarm occurrence.

Type of fault	Item	Operation mode	
		Net mode	PU mode
Inverter (Note 3)	Inverter operation	Stop	Stop
	Network communication	Continue	Continue
DeviceNet (Note 4) Communication	Inverter operation	Stop (Note 1)	Continue
	Network communication	Continue (Note 2)	Continue (note 2)

Note: 1. Inverter operation stops on expiration of Inactivity/Watchdog timer of Connection Object.

2. Depends on the type of communication fault.

3. Examples, E.OPT, E.OC1.

4. Examples, Status LED is Blinking Red LED, Red LED.

Please refer to Page 127 for more details.

### 3.3.6 Inverter reset

Inverter reset behavior is as explained on page 53.

### 3.3.7 Setting frequency (f) value

Frequency setting in RAM can be made using Class 0x2A - Instance 1 - Attributes 112, 113. (Refer to Page 170)

### 3.3.8 Parameter clear (Pr Clr) commands

To execute the parameter clear commands, use Class 0x2A - Instance 1 - Attributes 102 to 106.

### 3.3.9 Control input commands

To send any control input command, use Class 0x2A - Instance 1 - Attribute 114. For example, setting it with value 0x0002 will cause the inverter to run forward (FWD) at the frequency value set in RAM.

Refer to the following bitmap tables for details:

7	6	5	4	3	2	1	0
0	0	RL *	RM *	RH *	STR	STF	0

15	14	13	12	11	10	9	8
0	0	0	0	0	MRS *	0	0

\* Input terminal function choices (Pr.180 to Pr.183) change terminal functions.

# CHAPTER 4

## PARAMETERS

This chapter explains the "parameters" of this product. With the factory settings, the inverter is designed to perform simple variable-speed operation. Set necessary parameter values according to the load and operating specifications. Always read the instructions before using the equipment.

4.1 Parameter List .....	55
4.2 Parameter Function Details .....	62

Note: By making parameter setting, you can change the functions of contact input terminals MRS and contact output terminals A, B, C. Therefore, signal names corresponding to the functions are used in the description of this chapter (except in the wiring examples). Note that they are not terminal names.

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# 4.1 Parameter List

## PARAMETERS

### 4.1.1 Parameter list

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
Basic functions	0	Torque boost (Note 1)	0 to 30%	0.1%	6%	62	
	1	Maximum frequency	0 to 120Hz	0.01Hz	120Hz	63	
	2	Minimum frequency	0 to 120Hz	0.01Hz	0Hz	63	
	3	Base frequency (Note 1)	0 to 400Hz	0.01Hz	60Hz	64	
	4	Multi-speed setting (high speed)	0 to 400Hz	0.01Hz	60Hz	65	
	5	Multi-speed setting (middle speed)	0 to 400Hz	0.01Hz	30Hz	65	
	6	Multi-speed setting (low speed)	0 to 400Hz	0.01Hz	10Hz	65	
	7	Acceleration time	0 to 3600 s/ 0 to 360 s	0.1 s/0.01 s	5 s/10s (Note 2)	66	
	8	Deceleration time	0 to 3600 s/ 0 to 360 s	0.1 s/0.01 s	5 s/10s (Note 2)	66	
	9	Electronic thermal O/L relay	0 to 500A	0.01A	Rated output current (Note 3)	68	
Standard operation functions	10	DC injection brake operation frequency	0 to 120Hz	0.01Hz	3Hz	69	
	11	DC injection brake operation time	0 to 10 s	0.1 s	0.5 s	69	
	12	DC injection brake voltage	0 to 30%	0.1%	6%	69	
	13	Starting frequency	0 to 60Hz	0.01Hz	0.5Hz	70	
	14	Load pattern selection (Note 1)	0 to 3	1	0	71	
	18	High-speed maximum frequency	120 to 400Hz	0.1Hz	120Hz	63	
	19	Base frequency voltage (Note 1)	0 to 1000V, 8888,9999	0.1V	9999	64	
	20	Acceleration/deceleration reference frequency	1 to 400Hz	0.01Hz	60Hz	66	
	21	Acceleration/deceleration time increments	0, 1	1	0	66	
	22	Stall prevention operation level	0 to 200%	0.1%	150%	72	
	23	Stall prevention operation level compensation factor at double speed (Note 4)	0 to 200%, 9999	0.1%	9999	72	
	24	Multi-speed setting (speed 4)	0 to 400Hz, 9999	0.01Hz	9999	65	
	25	Multi-speed setting (speed 5)	0 to 400Hz, 9999	0.01Hz	9999	65	
	26	Multi-speed setting (speed 6)	0 to 400Hz, 9999	0.01Hz	9999	65	
	27	Multi-speed setting (speed 7)	0 to 400Hz, 9999	0.01Hz	9999	65	
	29	Acceleration/deceleration pattern	0, 1, 2	1	0	74	
30	Regenerative function selection	0, 1	1	0	75		

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
Standard operation functions	31	Frequency jump 1A	0 to 400Hz, 9999	0.01Hz	9999	76	
	32	Frequency jump 1B	0 to 400Hz, 9999	0.01Hz	9999	76	
	33	Frequency jump 2A	0 to 400Hz, 9999	0.01Hz	9999	76	
	34	Frequency jump 2B	0 to 400Hz, 9999	0.01Hz	9999	76	
	35	Frequency jump 3A	0 to 400Hz, 9999	0.01Hz	9999	76	
	36	Frequency jump 3B	0 to 400Hz, 9999	0.01Hz	9999	76	
	37	Speed display	0, 0.01 to 9998	0.001 r/min	0	77	
Output terminal functions	41	Up-to-frequency sensitivity	0 to 100%	0.1%	10%	78	
	42	Output frequency detection	0 to 400Hz	0.01Hz	6Hz	78	
	43	Output frequency detection for reverse rotation	0 to 400Hz, 9999	0.01Hz	9999	78	
Second functions	44	Second acceleration/ deceleration time	0 to 3600 s /0 to 360 s	0.1 s/0.01 s	5s	66	
	45	Second deceleration time	0 to 3600 s /0 to 360 s, 9999	0.1 s/0.01 s	9999	66	
	46	Second torque boost (Note 1)	0 to 30%, 9999	0.1%	9999	62	
	47	Second V/F (base frequency) (Note 1)	0 to 400Hz, 9999	0.01Hz	9999	64	
	48	Second electronic overcurrent protection	0 to 500A, 9999	0.01A	9999	68	
Display functions	52	PU main display data selection	0, 23, 100	1	0	79	
Automatic restart functions	57	Restart coasting time	0 to 5 s, 9999	0.1 s	9999	81	
	58	Restart cushion time	0 to 60 s	0.1 s	1.0 s	81	
Operation selection functions	60	Shortest acceleration/ deceleration mode	0, 1, 2, 11, 12	1	0	82	
	61	Reference I for intelligent mode	0 to 500A, 9999	0.01A	9999	82	
	62	ref. I for intelligent mode accel	0 to 200%, 9999	1%	9999	82	
	63	ref. I for intelligent mode decel	0 to 200%, 9999	1%	9999	82	
	65	Retry selection	0, 1, 2, 3	1	0	84	
	66	Stall prevention operation level reduction starting frequency (Note 4)	0 to 400Hz	0.01Hz	60Hz	72	
	67	Number of retries at alarm occurrence	0 to 10, 101 to 110	1	0	84	
	68	Retry waiting time	0.1 to 360 s	0.1 s	1 s	84	
	69	Retry count display erasure	0	1	0	84	
	70	Special regenerative brake duty	0 to 30%	0.1%	0%	75	

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
Operation selection functions	71	Applied motor (Note 4)	0, 1, 3, 5, 6, 13, 15, 16, 23, 100, 101, 103, 105, 106, 113, 115, 116, 123,	1	0	86	
	72	PWM frequency selection	0 to 15	1	1	87	
	75	Reset selection/ disconnected PU detection/ PU stop selection	0 to 3, 14 to 17	1	14	88	
	77	Parameter write disable selection	0, 2	1	0	90	
	78	Reverse rotation prevention selection	0, 1, 2	1	0	90	
	79	Operation mode selection (Note 4)	0, 1, 2	1	2	91	
Motor constants	80	Motor capacity (Note 4)	0.1 to 7.5kW, 9999	0.01kW	9999	92	
	82	Motor exciting current	0 to 500A, 9999	0.01A	9999	93	
	83	Rated motor voltage (Note 4)	0 to 1000V	0.1V	200V	93	
	84	Rated motor frequency (Note 4)	50 to 120Hz	0.01Hz	60Hz	93	
	90	Motor constant (R1)	0 to 50Ω, 9999	0.001Ω	9999	93	
	96	Auto-tuning setting/status (Note 4)	0, 1	1	0	93	
Communication functions	117	Station number	0 to 31	1	0	99	
	118	Communication speed	48, 96, 192	1	192	99	
	119	Stop bit length	0, 1 (data length 8) 10, 11 (data length 7)	1	1	99	
	120	Parity check presence/absence	0, 1, 2	1	2	99	
	121	Number of communication retries	0 to 10,9999	1	1	99	
	122	Communication check time interval	0, 0.1 to 999.8 s, 9999	0.1 s	0	99	
	123	Waiting time setting	0 to 150, 9999	1	9999	99	
	124	CR • LF presence/absence selection	0, 1, 2	1	1	99	
Display	145	Parameter unit display language selection	0 to 7	1	0	112	
Current detection	150	Output current detection level	0 to 200%	0.1%	150%	113	
	151	Output current detection period	0 to 10 s	0.1 s	0	113	
	152	Zero current detection level	0 to 200.0%	0.1%	5.0%	114	
	153	Zero current detection period	0.05 to 1 s	0.01 s	0.5 s	114	



Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
Sub function	156	Stall prevention operation selection	0 to 31,100	1	0	115	
Additional function	160	User group read selection	0, 1, 10, 11	1	0	117	
	168	Parameters set by manufacturer. Do not set.					
	169						
Initial monitor	171	Actual operation hour meter clear	0	—	0	118	
User functions	173	User group 1 registration	0 to 999	1	0	117	
	174	User group 1 deletion	0 to 999, 9999	1	0	117	
	175	User group 2 registration	0 to 999	1	0	117	
	176	User group 2 deletion	0 to 999, 9999	1	0	117	
Terminal (DeviceNet I/O) assignment functions	180	(RL) function selection (Note 4)	0 to 18	1	0	118	
	181	(RM) function selection (Note 4)	0 to 18	1	1	118	
	182	(RH) function selection (Note 4)	0 to 18	1	2	118	
	183	MRS terminal (MRS) function selection (Note 4)	0 to 18	1	6	118	
	190	(RUN) function selection (Note 4)	0 to 99	1	0	120	
	191	(FU) function selection (Note 4)	0 to 99	1	4	120	
	192	A, B, C terminal (ABC) function selection (Note 4)	0 to 99	1	99	120	
Multi-speed operation	232	Multi-speed setting (speed 8)	0 to 400Hz, 9999	0.01Hz	9999	65	
	233	Multi-speed setting (speed 9)	0 to 400Hz, 9999	0.01Hz	9999	65	
	234	Multi-speed setting (speed 10)	0 to 400Hz, 9999	0.01Hz	9999	65	
	235	Multi-speed setting (speed 11)	0 to 400Hz, 9999	0.01Hz	9999	65	
	236	Multi-speed setting (speed 12)	0 to 400Hz, 9999	0.01Hz	9999	65	
	237	Multi-speed setting (speed 13)	0 to 400Hz, 9999	0.01Hz	9999	65	
	238	Multi-speed setting (speed 14)	0 to 400Hz, 9999	0.01Hz	9999	65	
	239	Multi-speed setting (speed 15)	0 to 400Hz, 9999	0.01Hz	9999	65	

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
Sub functions	240	Soft-PWM setting	0, 1	1	1	87	
	244	Cooling fan operation selection	0, 1	1	0	121	
	245	Rated motor slip	0 to 50%, 9999	0.01%	9999	122	
	246	Slip compensation response time	0.01 to 10 s	0.01 s	0.5 s	122	
	247	Constant-output region slip compensation selection	0, 9999	1	9999	122	
	249	Ground fault detection at start	0, 1	1	0	123	
Stop selection function	250	Stop selection	0 to 100 s, 1000 to 1100 s, 8888, 9999	1	9999	123	
DeviceNet functions	345	DeviceNet address startup data (Lower byte)	0 to 255	1	63 (0x3F)	125	
	346	DeviceNet baudrate startup data (Lower byte)	0 to 255	1	132 (0x84)	125	
	347	DeviceNet address startup data (Higher byte)	0 to 255	1	160 (0xA0)	125	
	348	DeviceNet baudrate startup data (Higher byte)	0 to 255	1	80 (0x50)	125	
Display	990	Buzzer beep control	0, 1	1	1	112	
	991	LCD contrast	0 to 63	1	53	112	

Note: 1. Indicates the parameter of which setting is ignored when the general-purpose magnetic flux vector control mode is selected.  
 2. The setting depends on the inverter capacity: (0.1K to 3.7K)/(5.5K to 7.5K).  
 3. Set to 85% of the rated inverter current for the 0.1K to 0.75K.  
 4. If "2" is set in Pr. 77 (parameter write inhibit selection), the setting cannot be changed during operation.  
 5. The half-tone screened parameters allow their settings to be changed during operation if "0" (factory setting) has been set in Pr. 77 (parameter write inhibit selection). (However, the Pr. 72 and Pr. 240 value may be changed during PU operation only.)

### 4.1.2 List of parameters classified by purpose of use

Set the parameters according to the operating conditions. The following list indicates purpose of use and corresponding parameters.

Purpose of Use		Parameter Numbers
		Parameter numbers which must be set
Related to operation	Operation mode selection	Pr. 79
	Acceleration/deceleration time/pattern adjustment	Pr. 7, Pr. 8, Pr. 20, Pr. 21, Pr. 29
	Selection of output characteristics optimum for load characteristics	Pr. 3, Pr. 14, Pr. 19
	Output frequency restriction (limit)	Pr. 1, Pr. 2, Pr. 18
	Operation over 60Hz	Pr. 1, Pr. 18
	Motor output torque adjustment	Pr. 0, Pr. 80
	Brake operation adjustment	Pr. 10, Pr. 11, Pr. 12
	Multi-speed operation	Pr. 1, Pr. 2, Pr. 4, Pr. 5, Pr. 6, Pr. 24, Pr. 25, Pr. 26, Pr. 27, Pr. 232, Pr. 233, Pr. 234, Pr. 235, Pr. 236, Pr. 237, Pr. 238, Pr. 239
	Frequency jump operation	Pr. 31, Pr. 32, Pr. 33, Pr. 34, Pr. 35, Pr. 36
	Automatic restart operation after instantaneous power failure	Pr. 57, Pr. 58
	Optimum acceleration/deceleration within continuous rated range	Pr. 60
	Slip compensation setting	Pr. 245 to Pr. 247
	Output stop method selection	Pr. 250
Setting of output characteristics matching the motor	Pr. 3, Pr. 19, Pr. 71	
Related to application operation	General-purpose magnetic flux vector control operation	Pr. 80
	Electromagnetic brake operation timing	Pr. 42, Pr. 190 to Pr. 192
	Offline auto tuning setting	Pr. 82 to Pr. 84, Pr. 90, Pr. 96
	Sub-motor operation	Pr. 0, Pr. 3, Pr. 7, Pr. 8, Pr. 9, Pr. 44, Pr. 45, Pr. 46, Pr. 47, Pr. 48
	Regenerative function selection	Pr. 30, Pr. 70
	Operation in communication with personal computer	Pr. 117 to Pr. 124
	Noise reduction	Pr. 72, Pr. 240

Purpose of Use		Parameter Numbers
		Parameter numbers which must be set
Related to monitoring	Display of speed, etc.	Pr. 37, Pr. 52
	Clearing of inverter's actual operation time	Pr. 171
Related to incorrect operation prevention	Function write prevention	Pr. 77
	Reverse rotation prevention	Pr. 78
	Parameter grouping	Pr. 160, Pr. 173 to Pr. 176
	Current detection	Pr. 150 to Pr. 153, Pr. 190 to Pr. 192
	Motor stall prevention	Pr. 22, Pr. 23, Pr. 66, Pr. 156
Others	Input terminal (DeviceNet input) function assignment	Pr. 180 to Pr. 183
	Output terminal (DeviceNet output) function assignment	Pr. 190 to Pr. 192
	Increased cooling fan life	Pr. 244
	Motor protection from overheat	Pr. 9, Pr. 71
	Automatic restart operation at alarm stop	Pr. 65, Pr. 67, Pr. 68, Pr. 69
	Setting of ground fault overcurrent protection	Pr. 249
	Inverter reset selection	Pr. 75

### 4.1.3 Parameters recommended to be set by the user

We recommend the following parameters to be set by the user.

Set them according to the operation specifications, load, etc.

Parameter Number	Name	Application
1	Maximum frequency	Used to set the maximum and minimum output frequencies.
2	Minimum frequency	
7	Acceleration time	Used to set the acceleration and deceleration times.
8	Deceleration time	
9	Electronic thermal O/L relay	Used to set the current of the electronic overcurrent protection to protect the motor from overheat.
14	Load pattern selection	Used to select the optimum output characteristics which match the application and load characteristics.
71	Applied motor	Used to set the thermal characteristics of the electronic overcurrent protection according to the motor used.

## 4.2 Parameter Function Details

### 4.2.1 Torque boost (Pr. 0, Pr. 46)

#### Pr. 0 "torque boost"

#### Pr. 46 "second torque boost"

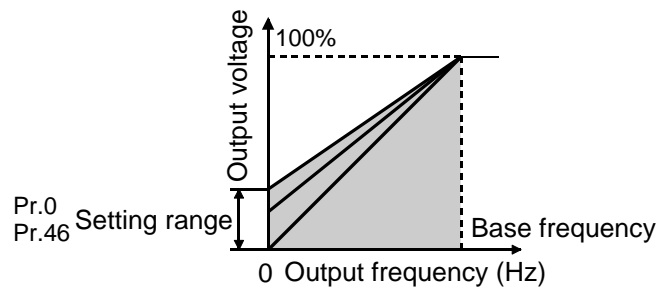
#### Related parameters

- Pr. 3 "base frequency"
- Pr. 19 "base frequency voltage"
- Pr. 71 "applied motor"
- Pr. 80 "motor capacity"
- Pr. 180 to Pr. 183 (input terminal (DeviceNet input) function selection)

Increase the setting when the inverter-to-motor distance is long or motor torque in the low-speed range is insufficient, for example;

- Motor torque in the low-frequency range can be adjusted to the load to increase the starting motor torque.
- You can select either of the two starting torque boosts by RT terminal switching.

Parameter Number	Factory Setting	Setting Range	Remarks
0	6%	0 to 30%	—
46	9999	0 to 30%, 9999	9999: Function invalid



#### <Setting>

- Assuming that the base frequency voltage is 100%, set the 0Hz voltage in %.
- Pr. 46 "Second torque boost" is valid when the RT signal is on. (Note 3)
- When using the inverter-dedicated motor (constant-torque motor), change the setting as indicated below:  
FR-E520-0.1KND to 0.75KND ..... 6%  
FR-E520-1.5KND to 7.5KND ..... 4%  
If you leave the factory setting as it is and change the Pr. 71 value to the setting for use of the constant-torque motor, the Pr. 0 setting changes to the above value.

Note: 1. This parameter setting is ignored when the general-purpose magnetic flux vector control mode has been selected.  
2. A large setting may result in an overheated motor or overcurrent trip. The guideline for the largest value for this parameter is about 10%.  
3. The RT signal serves as the second function selection signal and makes the other second functions valid. Refer to page 118 for Pr. 180 to Pr. 183 (input terminal (DeviceNet input) function selection).  
4. When terminal (DeviceNet input) assignment is changed using Pr. 180 to Pr. 183 during use of the second functions, the other functions may be affected. Check the functions of the corresponding terminals (DeviceNet input) before making setting.

### 4.2.2 Output frequency range (Pr. 1, Pr. 2, Pr. 18)

**Pr. 1 "maximum frequency"**

**Pr. 2 "minimum frequency"**

**Pr. 18 "high-speed maximum frequency"**

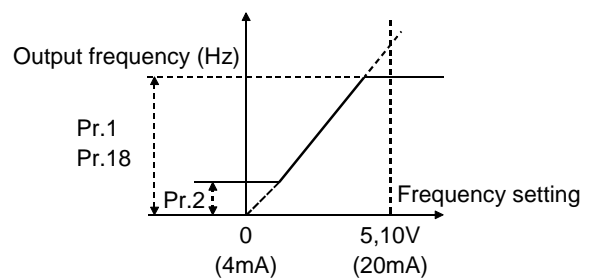
Used to clamp the upper and lower limits of the output frequency. Used for high-speed operation at or over 120Hz.

- Can be used to set the upper and lower limits of motor speed.

**Related parameters**

Pr. 13 "starting frequency"  
Pr. 79 "operation mode selection"

Parameter Number	Factory Setting	Setting Range
1	120Hz	0 to 120Hz
2	0Hz	0 to 120Hz
18	120Hz	120 to 400Hz



**<Setting>**

- Use Pr. 1 to set the upper limit of the output frequency. If the frequency of the frequency command entered is higher than the setting, the output frequency is clamped at the maximum frequency.
- To perform operation over 120Hz, set the upper limit of the output frequency in Pr. 18.  
(When the Pr. 18 value is set, Pr. 1 automatically changes to the frequency in Pr. 18. Also, when the Pr. 1 value is set, Pr. 18 automatically changes to the frequency in Pr. 1.)
- Use Pr. 2 to set the lower limit of the output frequency.

**⚠ CAUTION**

**⚠ When the Pr. 2 setting is higher than the Pr. 13 "starting frequency" value, note that the motor will run at the set frequency by merely switching the start signal on, without entering the command frequency.**

### 4.2.3 Base frequency, base frequency voltage (Pr. 3, Pr. 19, Pr. 47)

**Pr. 3 "base frequency"**

**Pr. 19 "base frequency voltage"**

**Pr. 47 "second V/F (base frequency)"**

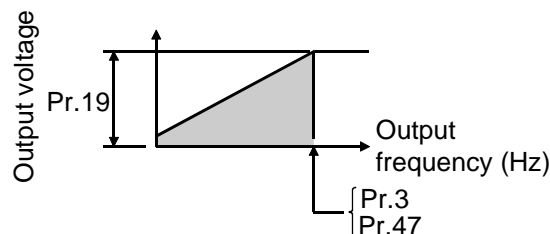
**Related parameters**

- Pr. 14 "load pattern selection"
- Pr. 71 "applied motor"
- Pr. 80 "motor capacity"
- Pr. 83 "rated motor voltage"
- Pr. 180 to Pr. 183 (input terminal (DeviceNet input) function selection)

Used to adjust the inverter outputs (voltage, frequency) to the motor rating.

- When running a standard motor, generally set the rated motor frequency. When running the motor using the commercial power supply-inverter switch-over, set the base frequency to the same value as the power supply frequency.
- If the frequency given on the motor rating plate is "50Hz" only, always set to "50Hz". Leaving it as "60Hz" may make the voltage too low and the torque less, resulting in overload tripping. Care must be taken especially when Pr. 14 "load pattern selection" = 1.

Parameter Number	Factory Setting	Setting Range	Remarks
3	60Hz	0 to 400Hz	
19	9999	0 to 1000V, 8888, 9999	8888: 95% of power supply voltage 9999: Same as power supply voltage
47	9999	0 to 400Hz, 9999	9999: Function invalid



**<Setting>**

- Use Pr. 3 and Pr. 47 to set the base frequency (rated motor frequency). Two base frequencies can be set and the required frequency can be selected from them.
- Pr. 47 "Second V/F (base frequency)" is valid when the RT signal is on. (Note 3)
- Use Pr. 19 to set the base voltage (e.g. rated motor voltage).

Note: 1. Set 60Hz in Pr. 3 "base frequency" when using a Mitsubishi constant-torque motor.

2. When the general-purpose magnetic flux vector control mode has been selected, Pr. 3, Pr. 19 and Pr. 47 are made invalid and Pr. 83 and Pr. 84 are made valid. However, Pr. 3 or Pr. 47 is made valid for the S-shaped inflection pattern point of Pr. 29.

3. The RT signal serves as the second function selection signal and makes the other second functions valid. Refer to page 118 for Pr. 180 to Pr. 183 (input terminal (DeviceNet input) function selection).

### 4.2.4 Multi-speed operation (Pr. 4, Pr. 5, Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239)

**Pr. 4 "multi-speed setting (high speed)"**

**Pr. 5 "multi-speed setting (middle speed)"**

**Pr. 6 "multi-speed setting (low speed)"**

**Pr. 24 to Pr. 27 "multi-speed setting (speeds 4 to 7)"**

**Pr. 232 to Pr. 239 "multi-speed setting (speeds 8 to 15)"**

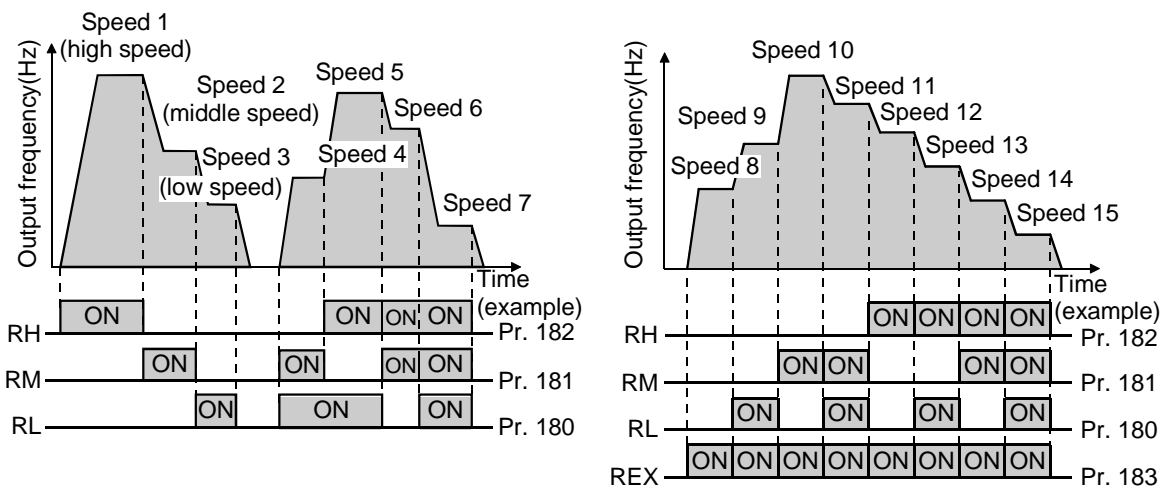
**Related parameters**

- Pr. 1 "maximum frequency"
- Pr. 2 "minimum frequency"
- Pr. 29 "acceleration/deceleration pattern"
- Pr. 79 "operation mode selection"
- Pr. 180 to Pr. 183 (input terminal (DeviceNet input) function selection)

Used to switch between the predetermined running speeds.

- Each speed can be selected just by turning the RH, RM, RL and REX signals (DeviceNet input) ON and OFF.
- By using these functions with Pr. 1 "maximum frequency" and Pr. 2 "minimum frequency", up to 17 speeds can be set.
- Valid in the DeviceNet™ operation mode.

Parameter Number	Factory Setting	Setting Range	Remarks
4	60Hz	0 to 400Hz	
5	30Hz	0 to 400Hz	
6	10Hz	0 to 400Hz	
24 to 27	9999	0 to 400Hz, 9999	9999: Not selected
232 to 239	9999	0 to 400Hz, 9999	9999: Not selected



**<Setting>**

- Set the running frequencies in the corresponding parameters.
- Each speed (frequency) can be set as desired between 0 and 400Hz during inverter operation. When the parameter unit (FR-PU04) is used, the setting of the required multi-speed setting parameter that has been read can be changed by pressing the / key. In this case, when you release the / key, press the key to store the set frequency.



- Note: 1. The multi-speeds can also be set in the PU or DeviceNet operation mode.  
 2. For 3-speed setting, if two or three speeds are simultaneously selected, priority is given to the frequency setting of the lower signal.  
 3. Pr. 24 to Pr. 27 and Pr. 232 to Pr. 239 settings have no priority between them.  
 4. The parameter values can be changed during operation.  
 5. When input terminal (DeviceNet input) assignment is changed using Pr. 180 to Pr. 183, the other functions may be affected. Check the functions of the corresponding terminals (DeviceNet input) before making setting.

**4.2.5 Acceleration/deceleration time (Pr. 7, Pr. 8, Pr. 20, Pr. 21, Pr. 44, Pr. 45)**

**Pr. 7 "acceleration time"**

**Pr. 8 "deceleration time"**

**Pr. 20 "acceleration/deceleration reference frequency"**

**Pr. 21 "acceleration/deceleration time increments"**

**Pr. 44 "second acceleration/deceleration time"**

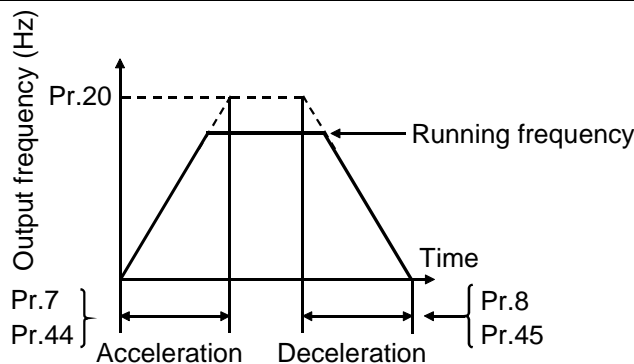
**Pr. 45 "second deceleration time"**

**Related parameters**  
 Pr. 3 "base frequency"  
 Pr. 29 "acceleration/deceleration pattern"

Used to set motor acceleration/deceleration time.

Set a larger value for a slower speed increase/decrease or a smaller value for a faster speed increase/decrease.

Parameter Number	Factory Setting		Setting Range	Remarks
7	0.1K to 3.7K	5s	0 to 3600s/0 to 360s	
	5.5K, 7.5K	10s		
8	0.1K to 3.7K	5s	0 to 3600s/0 to 360s	
	5.5K, 7.5K	10s		
20	60Hz		1 to 400Hz	
21	0		0, 1	0: 0 to 3600s 1: 0 to 360s
44	5s		0 to 3600s/0 to 360s	
45	9999		0 to 3600s/ 0 to 360s, 9999	9999: acceleration time = deceleration time



**<Setting>**

- Use Pr. 21 to set the acceleration/deceleration time and minimum setting increments:  
 Set value "0" (factory setting).... 0 to 3600s (minimum setting increments: 0.1s)  
 Set value "1"..... 0 to 360s (minimum setting increments: 0.01s)
- Use Pr. 7 and Pr. 44 to set the acceleration time required to reach the frequency set in Pr. 20 from 0Hz.
- Use Pr. 8 and Pr. 45 to set the deceleration time required to reach 0Hz from the frequency set in Pr. 20.
- Pr. 44 and Pr. 45 are valid when the RT signal is on.
- Set "9999" in Pr. 45 to make the deceleration time equal to the acceleration time (Pr. 44).

Note:1. In S-shaped acceleration/deceleration pattern A (refer to page 74), the set time is the period required to reach the base frequency set in Pr. 3.

- Acceleration/deceleration time calculation expression when the set frequency is the base frequency or higher

$$t = \frac{4}{9} \times \frac{T}{(\text{Pr. 3})^2} \times f^2 + \frac{5}{9} T$$

T: Acceleration/deceleration time setting (s)

f : Set frequency (Hz)

- Guideline for acceleration/deceleration time at the base frequency of 60Hz (0Hz to set frequency)

Frequency setting (Hz) Acceleration/ deceleration time (s)	60	120	200	400
5	5	12	27	102
15	15	35	82	305

2. When the setting of Pr. 7, Pr. 8, Pr. 44 or Pr. 45 is "0", the acceleration/deceleration time is 0.04 seconds. At this time, set 120Hz or less in Pr. 20.
3. When the RT signal is on, the other second functions such as second torque boost are also selected.
4. If the shortest acceleration/deceleration time is set, the actual motor acceleration/deceleration time cannot be made shorter than the shortest acceleration/deceleration time determined by the mechanical system's J (inertia moment) and motor torque.

## 4.2.6 Electronic overcurrent protection (Pr. 9, Pr. 48)

### Pr. 9 "electronic thermal O/L relay"

### Pr. 48 "second electronic overcurrent protection"

#### Related parameter

Pr. 71 "applied motor"  
Pr. 180 to Pr. 183  
(input terminal (DeviceNet input) function selection)

Set the current of the electronic overcurrent protection to protect the motor from overheat. This feature provides the optimum protective characteristics, including reduced motor cooling capability, at low speed.

Parameter Number	Factory Setting	Setting Range	Remarks
9	Rated output current*	0 to 500A	
48	9999	0 to 500A, 9999	9999: Function invalid

\*0.1K and 0.75K are set to 85% of the rated inverter current.

#### <Setting>

- Set the rated current [A] of the motor.  
(Normally set the rated current at 50Hz if the motor has both 50Hz and 60Hz rated current.)
- Setting "0" makes the electronic overcurrent protection (motor protective function) invalid. (The inverter's protective function is valid.)
- When using a Mitsubishi constant-torque motor, first set "1" in Pr. 71 to choose the 100% continuous torque characteristic in the low-speed range. Then, set the rated motor current in Pr. 9.
- Pr. 48 "Second electronic overcurrent protection" is made valid when the RT signal is on. (Note 4)

Note:1. When two or more motors are connected to the inverter, they cannot be protected by the electronic overcurrent protection. Install an external thermal relay to each motor.

2. When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic overcurrent protection will be deteriorated. In this case, use an external thermal relay.

3. A special motor cannot be protected by the electronic overcurrent protection. Use an external thermal relay.

4. The RT signal serves as the second function selection signal and makes the other second functions valid. Refer to page 118 for Pr. 180 to Pr. 183 (input (DeviceNet input) terminal function selection).

### 4.2.7 DC injection brake (Pr. 10 to Pr. 12)

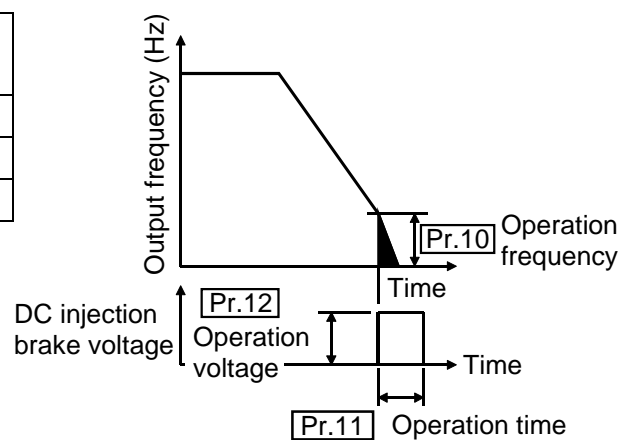
#### Pr. 10 "DC injection brake operation frequency"

#### Pr. 11 "DC injection brake operation time"

#### Pr. 12 "DC injection brake voltage"

By setting the DC injection brake voltage (torque), operation time and operation starting frequency, the stopping accuracy of positioning operation, etc. or the timing of operating the DC injection brake to stop the motor can be adjusted according to the load.

Parameter Number	Factory Setting	Setting Range
10	3Hz	0 to 120Hz
11	0.5 s	0 to 10 s
12	6%	0 to 30%



#### <Setting>

- Use Pr. 10 to set the frequency at which the DC injection brake operation is started.
- Use Pr. 11 to set the period during when the brake is operated.
- Use Pr. 12 to set the percentage of the power supply voltage.
- The setting value for Pr. 12 when using the inverter-dedicated motor (constant-torque motor).  
FR-E520-0.1KND to 7.5KND ..... 4% (Note)

Note: When the Pr. 12 value is as factory-set, changing the Pr. 71 value to the setting for use of a constant-torque motor changes the Pr. 12 value to 4% automatically.

**! CAUTION**

**! Install a mechanical brake. No holding torque is provided.**

## 4.2.8 Starting frequency (Pr. 13)

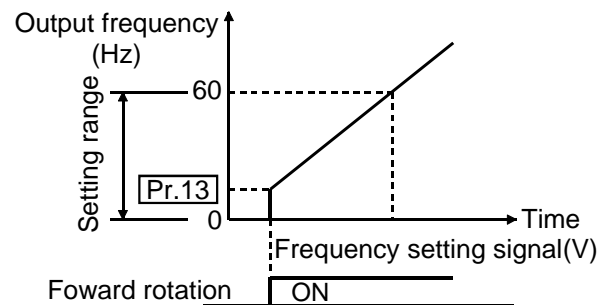
### Pr. 13 "starting frequency"

**Related parameters**  
Pr. 2 "minimum frequency"

You can set the starting frequency between 0 and 60Hz.

- Set the starting frequency at which the start signal is switched on.

Parameter Number	Factory Setting	Setting Range
13	0.5Hz	0 to 60Hz



**Note:** The inverter will not start if the frequency setting signal is less than the value set in Pr. 13 "starting frequency".

For example, when 5Hz is set in Pr. 13, the motor will not start running until the frequency setting signal reaches 5Hz.

### **! CAUTION**

- ! When the Pr. 13 setting is equal to or less than the Pr. 2 value, note that merely switching on the start signal will start the motor at the preset frequency if the command frequency is not input.**

## 4.2.9 Load pattern selection (Pr. 14)

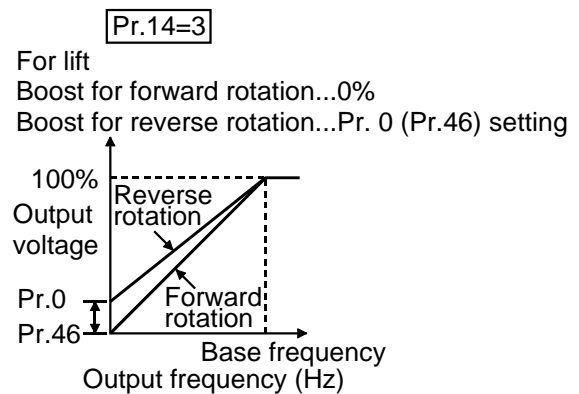
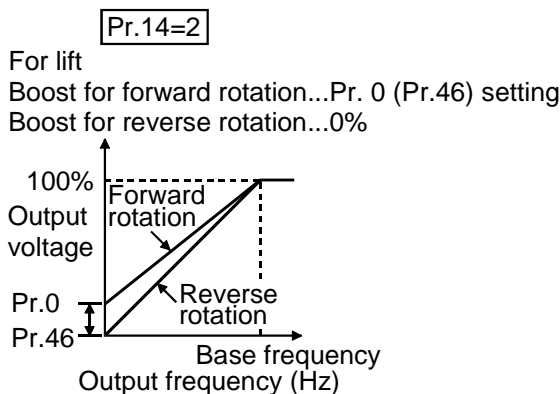
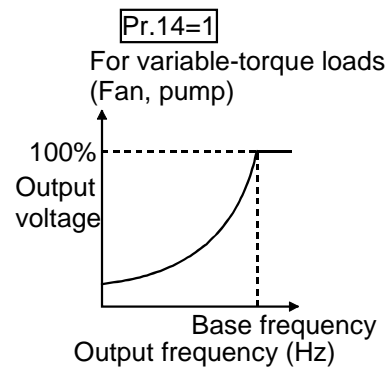
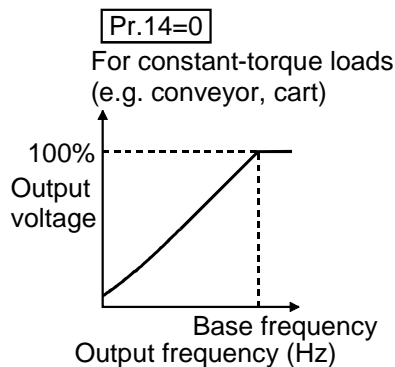
### Pr. 14 "load pattern selection"

#### Related parameters

Pr. 0 "torque boost"  
 Pr. 46 "second torque boost"  
 Pr. 80 "motor capacity"  
 Pr. 180 to Pr. 183  
 (input terminal (DeviceNet input)  
 function selection)

You can select the optimum output characteristic (V/F characteristic) for the application and load characteristics.

Parameter Number	Factory Setting	Setting Range
14	0	0 to 3



Note: 1. This parameter setting is ignored when the general-purpose magnetic flux vector control mode has been selected.  
 2. Pr. 46 "second torque boost" is made valid when the RT signal turns on. The RT signal acts as the second function selection signal and makes the other second functions valid.  
 Refer to page 118 for Pr. 180 to Pr. 183 (input terminal (DeviceNet input) function selection).

**Pr. 18 → Refer to Pr. 1, Pr. 2.**

**Pr. 19 → Refer to Pr. 3.**

**Pr. 20, Pr. 21 → Refer to Pr. 7, Pr. 8.**

### 4.2.10 Stall prevention (Pr. 22, Pr. 23, Pr. 66)

#### Pr. 22 "stall prevention operation level"

#### Pr. 23 "stall prevention operation level compensation factor at double speed"

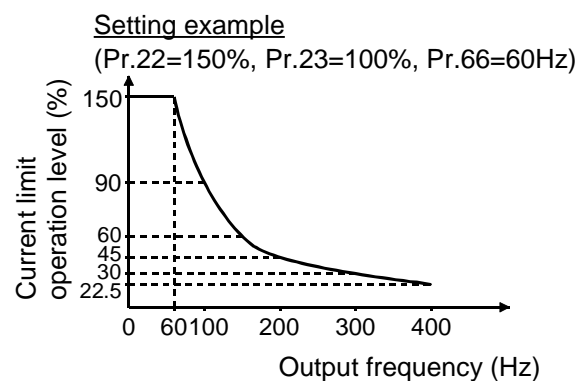
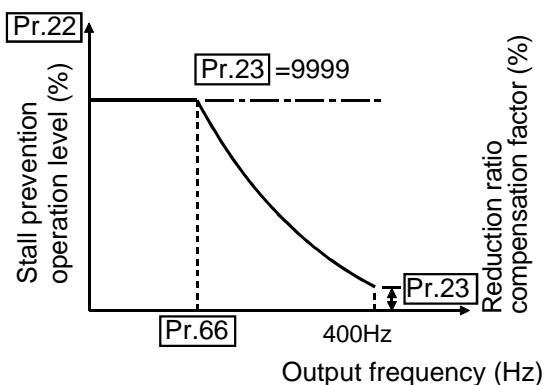
#### Related parameters

- Pr. 9 "electronic thermal O/L relay"
- Pr. 48 "second electronic overcurrent protection"

#### Pr. 66 "stall prevention operation level reduction starting frequency"

- Set the output current level at which the output frequency will be adjusted to prevent the inverter from stopping due to overcurrent etc.
- For high-speed operation at or over the motor base frequency, acceleration may not be made because the motor current does not increase.  
To improve the operation characteristics of the motor in such a case, the stall prevention level in the high-frequency range can be reduced. This is effective for operation of a centrifugal separator up to the high-speed range. Normally, set 60Hz in Pr. 66 and 100% in Pr. 23.
- For operation in the high-frequency range, the current in the locked motor state is smaller than the rated output current of the inverter and the inverter does not result in an alarm (protective function is not activated) if the motor is at a stop. To improve this and activate the alarm, the stall prevention level can be reduced.

Parameter Number	Factory Setting	Setting Range	Remarks
22	150%	0 to 200%	
23	9999	0 to 200%, 9999	9999: Constant according to Pr. 22
66	60Hz	0 to 400Hz	



## &lt;Setting&gt;

- In Pr. 22, set the stall prevention operation level. Normally set it to 150% (factory setting). Set "0" in Pr. 22 to disable the stall prevention operation.
- To reduce the stall prevention operation level in the high-frequency range, set the reduction starting frequency in Pr. 66 and the reduction ratio compensation factor in Pr. 23.

Calculation expression for stall prevention operation level


$$\text{Stall prevention operation level (\%)} = A + B \times \left[ \frac{\text{Pr. 22-A}}{\text{Pr. 22-B}} \right] \times \left[ \frac{\text{Pr. 23-100}}{100} \right]$$

$$\text{where, } A = \frac{\text{Pr. 66 (Hz)} \times \text{Pr. 22 (\%)}}{\text{output frequency (Hz)}}, \quad B = \frac{\text{Pr. 66 (Hz)} \times \text{Pr. 22 (\%)}}{400\text{Hz}}$$

- By setting "9999" (factory setting) in Pr. 23, the stall prevention operation level is constant at the Pr. 22 setting up to 400Hz.

Note: When the fast-response current limit has been set in Pr. 156 (factory setting has the current limit activated), do not set the Pr. 22 value to 170% or more. Torque will not be developed by doing so.

 **CAUTION**

 **Do not set a small value as the stall prevention operation current. Otherwise, torque generated will reduce.**

 **Test operation must be performed.**

**Stall prevention operation during acceleration may increase the acceleration time.**

**Stall prevention operation during constant speed may change the speed suddenly.**

**Stall prevention operation during deceleration may increase the deceleration time, increasing the deceleration distance.**

**Pr. 24 to Pr. 27 → Refer to Pr. 4 to Pr. 6.**



### 4.2.11 Acceleration/deceleration pattern (Pr. 29)

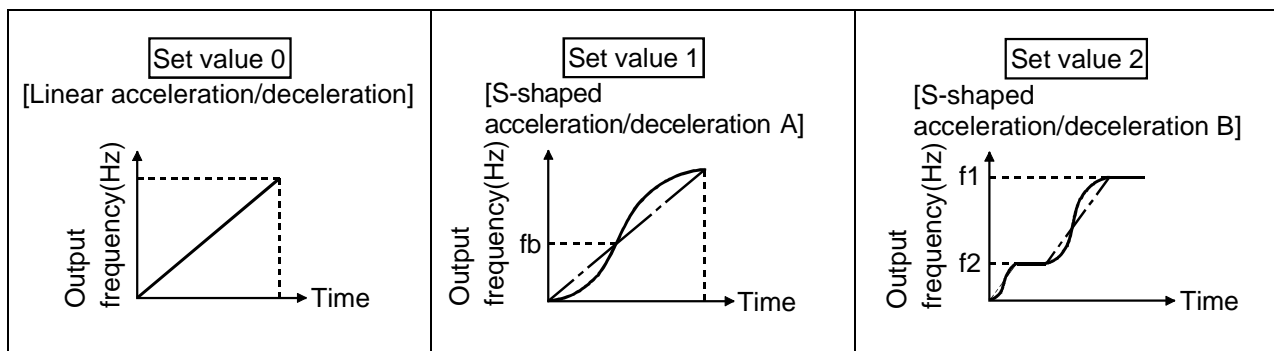
#### Pr. 29 "acceleration/deceleration pattern"

#### Related parameters

- Pr. 3 "base frequency"
- Pr. 7 "acceleration time"
- Pr. 8 "deceleration time"
- Pr. 20 "acceleration/deceleration reference frequency"
- Pr. 44 "second acceleration/deceleration time"
- Pr. 45 "second deceleration time"

Set the acceleration/deceleration pattern.

Parameter Number	Factory Setting	Setting Range
29	0	0, 1, 2



#### <Setting>

Pr. 29 Setting	Function	Description
0	Linear acceleration/deceleration	Linear acceleration/deceleration is made up/down to the preset frequency (factory setting).
1	S-shaped acceleration/deceleration A (Note)	For machine tool spindles This setting is used when it is necessary to make acceleration/deceleration in a short time up to the base frequency or higher speed range. In this acceleration/deceleration pattern, fb (base frequency) is always the inflection point of an S shape, and you can set the acceleration/deceleration time according to the reduction in motor torque in the base frequency or higher constant-output operation range.
2	S-shaped acceleration/deceleration B	For prevention of cargo collapse on conveyor, etc. This setting provides S-shaped acceleration/deceleration from f2 (current frequency) to f1 (target frequency), easing an acceleration/deceleration shock. This pattern has an effect on the prevention of cargo collapse, etc.

Note: For the acceleration/deceleration time, set the time required to reach the "base frequency" in Pr. 3, not the "acceleration/deceleration reference frequency" in Pr. 20. For details, refer to Pr. 7 and Pr. 8.

## 4.2.12 Regenerative brake duty (Pr. 30, Pr. 70)

### Pr. 30 "regenerative function selection"

### Pr. 70 "special regenerative brake duty"

- When making frequent starts/stops, use the optional "brake resistor" to increase the regenerative brake duty. (0.4K or more)

Parameter Number	Factory Setting	Setting Range
30	0	0,1
70	0%	0 to 30%

### <Setting>

#### (1) When using the brake resistor (MRS), brake unit, high power factor converter

- Set "0" in Pr. 30.
- The Pr. 70 setting is made invalid.

#### (2) When using the brake resistors (2 MYs in parallel) (3.7K is only allowed)

- Set "1" in Pr. 30.
- Set "6%" in Pr. 70.

#### (3) When using the high-duty brake resistor (FR-ABR)


- Set "1" in Pr. 30.
- Set "10%" in Pr. 70.

Note:1. Pr. 70 "regenerative brake duty" indicates the %ED of the built-in brake transistor operation. The setting should not be higher than the permissible value of the brake resistor used. Otherwise, the resistor can overheat.

2. When Pr. 30 = "0", Pr. 70 is not displayed but the brake duty is fixed at 3%. (Fixed at 2% for 5.5K, 7.5K)

3. The brake resistor cannot be connected to 0.1K and 0.2K inverters.

### WARNING

 The value set in Pr. 70 should not exceed the value set to the brake resistor used.  
Otherwise, the resistor can overheat.

### 4.2.13 Frequency jump (Pr. 31 to Pr. 36)

#### Pr. 31 "frequency jump 1A"

#### Pr. 32 "frequency jump 1B"

#### Pr. 33 "frequency jump 2A"

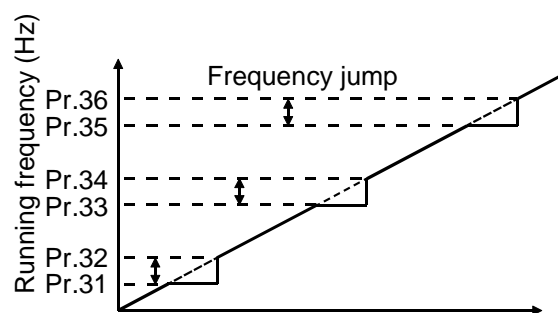
#### Pr. 34 "frequency jump 2B"

#### Pr. 35 "frequency jump 3A"

#### Pr. 36 "frequency jump 3B"

- When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be jumped. Up to three areas may be set, with the jump frequencies set to either the top or bottom point of each area.
- The value set to 1A, 2A or 3A is a jump point and operation is performed at this frequency.

Parameter Number	Factory Setting	Setting Range	Remarks
31	9999	0 to 400Hz, 9999	9999: Function invalid
32	9999	0 to 400Hz, 9999	9999: Function invalid
33	9999	0 to 400Hz, 9999	9999: Function invalid
34	9999	0 to 400Hz, 9999	9999: Function invalid
35	9999	0 to 400Hz, 9999	9999: Function invalid
36	9999	0 to 400Hz, 9999	9999: Function invalid



#### <Setting>

- To fix the frequency at 30Hz between Pr. 33 and Pr. 34 (30Hz and 35Hz), set 35Hz in Pr. 34 and 30Hz in Pr. 33.
- To jump to 35Hz between 30 and 35Hz, set 35Hz in Pr. 33 and 30Hz in Pr. 34.

Pr.34:35Hz .....  
Pr.33:30Hz .....

Pr.33:35Hz.....  
Pr.34:30Hz.....

Note: 1. During acceleration/deceleration, the running frequency within the set area is valid.

## 4.2.14 Speed display (Pr. 37)

### Pr. 37 "speed display"

#### Related parameter

Pr. 52 "PU main display data selection"

The unit of the output frequency display of the parameter unit (FR-PU04) can be changed from the frequency to the motor speed or machine speed.


Parameter Number	Factory Setting	Setting Range	Remarks
37	0	0, 0.01 to 9998	0: Output frequency

### <Setting>

- To display the machine speed, set in Pr. 37 the machine speed for 60Hz operation.

Note: 1. The motor speed is converted into the output frequency and does not match the actual speed.  
 2. To change the parameter unit (FR-PU04) monitor (PU main display), refer to Pr. 52.  
 3. Only the PU monitor display uses the unit set in this parameter. Set the other speed-related parameters (e.g. Pr. 1) in the frequency unit.  
 4. Due to the restrictions of the resolution of the set frequency, the displayed value may be different from the setting for the second decimal place.

### CAUTION

 **Make sure that the running speed setting is correct.**  
 Otherwise, the motor might run at extremely high speed, damaging the machine.

### 4.2.15 Up-to-frequency sensitivity (Pr. 41)

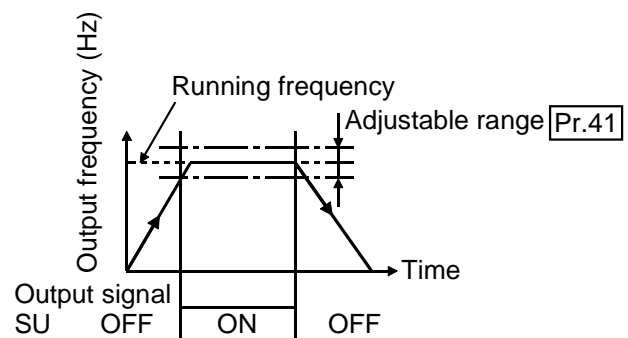
#### Pr. 41 "up-to-frequency sensitivity"

**Related parameters**  
Pr. 192 "A, B, C terminal (ABC) function selection"

The ON range of the up-to-frequency signal (SU) output when the output frequency reaches the running frequency can be adjusted between 0 and  $\pm 100\%$  of the running frequency.

This parameter can be used to ensure that the running frequency has been reached or used as the operation start signal etc. for related equipment.

Parameter Number	Factory Setting	Setting Range
41	10%	0 to 100%



- Use Pr. 192 to allocate the terminal used for SU signal output. Refer to page 120 for Pr. 192 "A, B, C terminal (ABC) function selection".
- The DeviceNet output is the 3-bit inverter status.

Note: When terminal assignment is changed using Pr. 192, the other functions may be affected. Check the functions of the corresponding terminals before making settings.

### 4.2.16 Output frequency detection (Pr. 42, Pr. 43)

#### Pr. 42 "output frequency detection"

**Related parameters**  
Pr. 192 "A, B, C terminal (ABC) function selection"

#### Pr. 43 "output frequency detection for reverse rotation"

The output frequency detection signal (FU) is output when the output frequency reaches or exceeds the setting. This function can be used for electromagnetic brake operation, open signal etc.

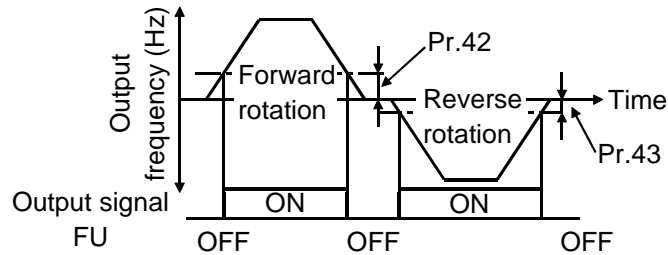
- You can also set the detection of the frequency used exclusively for reverse rotation. This function is effective for switching the timing of electromagnetic brake operation between forward rotation (rise) and reverse rotation (fall) during vertical lift operation etc.

Parameter Number	Factory Setting	Setting Range	Remarks
42	6Hz	0 to 400Hz	
43	9999	0 to 400Hz, 9999	9999: Same as Pr. 42 setting

**<Setting>**

Refer to the figure below and set the corresponding parameters:

- When Pr. 43 ≠ 9999, the Pr. 42 setting applies to forward rotation and the Pr. 43 setting applies to reverse rotation.
- Assign the terminal used for FU signal output with Pr. 192 "A, B, C terminal (ABC) function selection".  
Refer to page 120 for Pr. 192 "A, B, C terminal (ABC) function selection".
- The DeviceNet output is the 6-bit inverter status.



Note: Changing the terminal assignment using Pr. 192 may affect the other functions. Make setting after confirming the function of each terminal.

**Pr. 44, Pr. 45 → Refer to Pr. 7.**

**Pr. 46 → Refer to Pr. 0.**

**Pr. 47 → Refer to Pr. 3.**

**Pr. 48 → Refer to Pr. 9.**

**4.2.17 Monitor display (Pr. 52)**

**Pr. 52 "PU main display data selection"**

**Related parameters**  
 Pr. 37 "speed display"  
 Pr. 171 "actual operation hour meter clear"

You can select the signals shown on the parameter unit (FR-PU04) main display screen.

Parameter Number	Factory Setting	Setting Range
52	0	0, 23, 100

**<Setting>**

Set Pr. 52 and Pr. 54 in accordance with the following table:

Signal Type	Unit	Parameter Setting
		Pr. 52
		PU main monitor
Output frequency	Hz	0/100
Output current	A	0/100
Output voltage	—	0/100
Alarm display	—	0/100
Actual operation time	10h	23

When 100 is set in Pr. 52, the monitored values during stop and during operation differ as indicated below:

	Pr. 52		
	0	100	
	During operation/during stop	During stop	During operation
Output frequency	Output frequency	Set frequency	Output frequency
Output current	Output current		
Output voltage	Output voltage		
Alarm display	Alarm display		

- Note: 1. During an error, the output frequency at error occurrence is displayed.  
 2. During MRS, the values are the same as during a stop.  
 During offline auto tuning, the tuning status monitor has priority.

- Note: 1. By setting "0" in Pr. 52, the monitoring of "output frequency to alarm display" can be selected in sequence by the **(SHIFT)** key of the PU.  
 2. The actual operation time displayed by setting "23" in Pr. 52 is calculated using the inverter operation time. (Inverter stop time is not included.) Set "0" in Pr. 171 to clear it.  
 3. The actual operation time is calculated from 0 to 99990 hours, then cleared, and recalculated from 0. If the operation time is less than 10 hours there is no display.  
 4. The actual operation time is not calculated if the inverter has not operated for more than 1 hour continuously.

### 4.2.18 Automatic restart after instantaneous power failure (Pr. 57, Pr. 58)

#### Pr. 57 "restart coasting time"

#### Pr. 58 "restart cushion time"

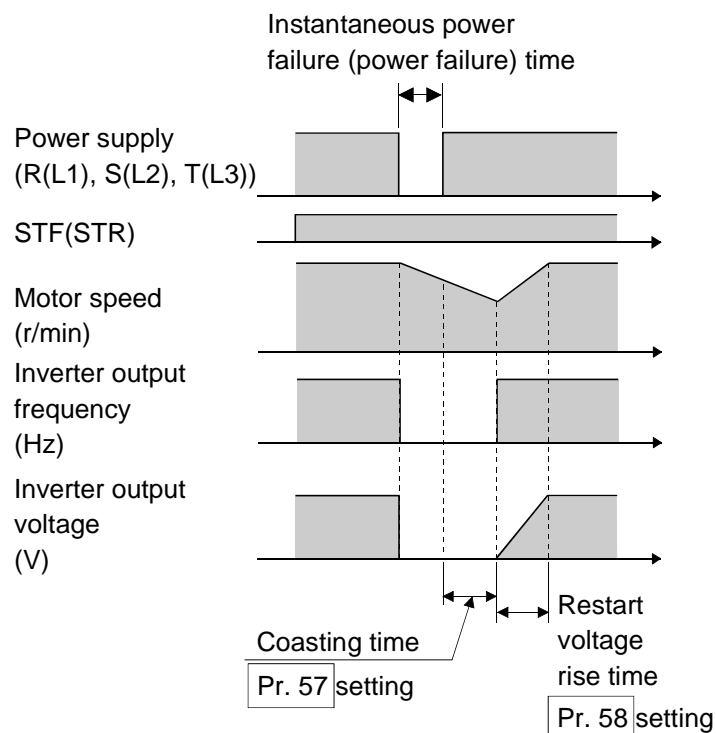
- You can restart the inverter without stopping the motor (with the motor coasting) when power is restored after an instantaneous power failure.

Parameter Number	Factory Setting	Setting Range	Remarks
57	9999	0 to 5 s, 9999	9999: No restart
58	1.0 s	0 to 60 s	

#### <Setting>

Refer to the following table and set the parameters:

Parameter Number	Setting	Description
57	0	0.1K to 1.5K
		2.2K to 7.5K
	0.1 to 5 s	Waiting time for inverter-triggered restart after power is restored from an instantaneous power failure. (Set this time between 0.1s and 5s according to the inertia moment (J) and torque of the load.)
	9999	No restart
58	0 to 60 s	Normally the inverter may be run with the factory settings. These values are adjustable to the load (inertia moment, torque).






Note: 1. Automatic restart after instantaneous power failure uses a reduced-voltage starting system in which the output voltage is raised gradually with the preset frequency unchanged, independently of the coasting speed of the motor. As in the FR-A024/044, a motor coasting speed detection system (speed search system) is not used but the output frequency before an instantaneous power failure is output. Therefore, if the instantaneous power failure time is longer than 0.2s, the frequency before the instantaneous power failure cannot be stored and the inverter will start at 0Hz.

2. The SU and FU signals are not output during restart but are output after the restart cushion time has elapsed.

**! CAUTION**

- ! When automatic restart after instantaneous power failure has been selected, the motor and machine will start suddenly (after the reset time has elapsed) after occurrence of an instantaneous power failure. Stay away from the motor and machine. When you have selected automatic restart after instantaneous power failure, apply the supplied CAUTION seals in easily visible places.**
- ! When the start signal is turned off or the  key of the PU is pressed during the cushion time for automatic restart after instantaneous power failure, deceleration starts after the automatic restart cushion time set in Pr. 58 "cushion time for automatic restart after instantaneous power failure" has elapsed.**

**4.2.19 Shortest acceleration/deceleration mode (Pr. 60 to Pr. 63)**

**Pr. 60 "shortest acceleration/deceleration mode"**

**Pr. 61 "reference I for intelligent mode"**

**Pr. 62 "ref. I for intelligent mode accel"**

**Pr. 63 "ref. I for intelligent mode decel"**

**Related parameters**

- Pr. 7 "acceleration time"
- Pr. 8 "deceleration time"

The inverter automatically sets appropriate parameters for operation.

- If you do not set the acceleration and deceleration times and V/F pattern, you can run the inverter as if appropriate values had been set in the corresponding parameters. This operation mode is useful to start operation immediately without making fine parameter settings.

Parameter Number	Factory Setting	Setting Range	Remarks
60	0	0, 1, 2, 11, 12	
61	9999	0 to 500A, 9999	9999: Referenced from rated inverter current.
62	9999	0 to 200%, 9999	
63	9999	0 to 200%, 9999	

**< Setting >**

Pr. 60 Setting	Operation Mode	Description	Automatically Set Parameters
0	Ordinary operation mode	_____	_____
1, 2, 11, 12	Shortest acceleration/ deceleration mode	<p>Set to accelerate/decelerate the motor in the shortest time.</p> <p>The inverter makes acceleration/deceleration in the shortest time using its full capabilities. During deceleration, an insufficient brake capability may cause the regenerative overvoltage alarm (E.OV3).</p> <p>"1" : Stall prevention operation level 150%</p> <p>"2" : Stall prevention operation level 180%</p> <p>"11": Stall prevention operation level 150% when brake resistor or brake unit is used</p> <p>"12": Stall prevention operation level 180% when brake resistor or brake unit is used</p>	Pr. 7, Pr. 8

**<Setting 2>**

- Set these parameters to improve performance in the intelligent mode.

**(1) Pr. 61 "reference I for intelligent mode"**

Setting	Reference Current
9999 (factory setting)	Referenced from rated inverter current
0 to 500A	Referenced from setting (rated motor current)

**(2) Pr. 62 "ref. I for intelligent mode accel"**

The reference current setting can be changed.

Setting	Reference Current
9999 (factory setting)	150% (180%) is the limit value.
0 to 200%	The setting of 0 to 200% is the limit value.

**(3) Pr. 63 "ref. I for intelligent mode decel"**

The reference current setting can be changed.

Setting	Reference Current
9999 (factory setting)	150% (180%) is the limit value.
0 to 200%	The setting of 0 to 200% is the limit value.

Note: Pr. 61 to Pr. 63 are only valid when any of "1, 2, 11, 12" are selected for Pr. 60.

## 4.2.20 Retry function (Pr. 65, Pr. 67 to Pr. 69)

### Pr. 65 "retry selection"

### Pr. 67 "number of retries at alarm occurrence"

### Pr. 68 "retry waiting time"

### Pr. 69 "retry count display erasure"

When any protective function (major fault) is activated and the inverter stops its output, the inverter itself resets automatically and performs retries. You can select whether retry is made or not, alarms reset for retry, number of retries made, and waiting time.

Parameter Number	Factory Setting	Setting Range
65	0	0 to 3
67	0	0 to 10, 101 to 110
68	1 s	0.1 to 360 s
69	0	0

### <Setting>

Use Pr. 65 to select the protective functions (major faults) which execute retry.

Errors Reset for Retry		Setting			
Function name		0	1	2	3
Overcurrent shut-off	During acceleration (OC1)	●	●		●
	During constant speed (OC2)	●	●		●
	During deceleration (OC3)	●	●		●
	During stop				
Regenerative overvoltage shut-off	During acceleration (OV1)	●		●	●
	During constant speed (OV2)	●		●	●
	During deceleration (OV3)	●		●	●
	During stop				
Overload shut-off (Electronic overcurrent protection)	Motor (THM)	●			
	Inverter (THT)	●			
Fin overheat (FIN)					
Brake transistor fault detection (BE)		●			
Output side ground fault overcurrent protection (GF)		●			
External thermal relay operation (OHT)		●			
Power limit stall prevention (OLT)		●			
Communication error (OPT)		●			
Parameter error (PE)		●			
PU disconnection occurrence (PUE)					
Retry count exceeded (RET)					
CPU error (CPU)					

Note: ● indicates the retry items selected.

Use Pr. 67 to set the number of retries at alarm occurrence.

Pr. 67 Setting	Number of Retries	Alarm Signal Output
0	Retry is not made.	————
1 to 10	1 to 10 times	Not output.
101 to 110	1 to 10 times	Output.


- Use Pr. 68 to set the waiting time from when an inverter alarm occurs until a restart in the range 0.1 to 360 seconds.
- Reading the Pr. 69 value provides the cumulative number of successful restart times made by retry. The setting of "0" erases the cumulative number of times.

Note: 1. The cumulative number in Pr. 69 is incremented by "1" when retry operation is regarded as successful, i.e. when normal operation is continued without the protective function (major fault) activated during a period five times longer than the time set in Pr. 68.

2. If the protective function (major fault) is activated consecutively within a period five times longer than the above waiting time, the parameter unit (FR-PU04) may show data different from the first retry data. The data stored as the error reset for retry is only that of the protective function (major fault) which was activated the first time.

3. When an inverter alarm is reset by the retry function at the retry time, the stored data of the electronic over current protection, etc. are not cleared. (Different from the power-on reset.)

 **CAUTION**

 **When you have selected the retry function, stay away from the motor and machine unless required. They will start suddenly (after the reset time has elapsed) after occurrence of an alarm.**

**When you have selected the retry function, apply the supplied CAUTION seals in easily visible places.**

**Pr. 66 → Refer to Pr. 22.**

**Pr. 70 → Refer to Pr. 30.**

## 4.2.21 Applied motor (Pr. 71)

### Pr. 71 "applied motor"

#### Related parameters

- Pr. 0 "torque boost"
- Pr. 12 "DC injection brake voltage"
- Pr. 19 "base frequency voltage"
- Pr. 80 "motor capacity"
- Pr. 96 "auto-tuning setting/status"

Set the motor used.

- When using the Mitsubishi constant-torque motor, set "1" in Pr. 71 for either V/F control or general-purpose magnetic flux vector control.  
The electronic overcurrent protection is set to the thermal characteristic of the constant-torque motor.

Parameter Number	Factory Setting	Setting Range
71	0	0, 1, 3, 5, 6, 13, 15, 16, 23, 100, 101, 103, 105, 106, 113, 115, 116, 123

#### <Setting>


- Refer to the following list and set this parameter according to the motor used.

Pr. 71 Setting	Thermal Characteristics of Electronic Overcurrent Protection		Applied motor	
			Standard	Constant-Torque
0, 100	Thermal characteristics matching a standard motor		○	
1, 101	Thermal characteristics matching the Mitsubishi constant-torque motor			○
3, 103	Standard motor	Select "offline auto tuning setting".	○	
13, 113	Constant-torque motor			○
23, 123	Mitsubishi general-purpose motor SF-JR4P (1.5kW or less)		○	
5, 105	Standard motor	Star connection	○	
15, 115	Constant-torque motor			
6, 106	Standard motor	Delta connection	○	
16, 116	Constant-torque motor			

By setting any of "100 to 123", the electronic overcurrent protection thermal characteristic (applied motor) can be changed as indicated below according to the ON/OFF status of the RT signal:

RT Signal	Electronic Overcurrent Protection Thermal Characteristic (Applied Motor)
OFF	As indicated in the above table
ON	Constant-torque motor

#### CAUTION

 **Set this parameter correctly according to the motor used. Incorrect setting may cause the motor to overheat and burn.**

## 4.2.22 PWM carrier frequency (Pr. 72, Pr. 240)

### Pr. 72 "PWM frequency selection"

### Pr. 240 "Soft-PWM setting"

You can change the motor tone.

- By parameter setting, you can select Soft-PWM control which changes the motor tone.
- Soft-PWM control changes motor noise from a metallic tone into an unoffending complex tone.

Parameter Number	Factory Setting	Setting Range	Remarks
72	1	0 to 15	0 : 0.7kHz, 15 : 14.5kHz
240	1	0, 1	1: Soft-PWM valid

### <Setting>

- Refer to the following list and set the parameters:


Parameter Number	Setting	Description
72	0 to 15	PWM carrier frequency can be changed. The setting displayed is in [kHz]. Note that 0 indicates 0.7kHz and 15 indicates 14.5kHz.
240	0	Soft-PWM invalid
	1	When any of "0 to 5" is set in Pr. 72, Soft-PWM is made valid.

- Note:1. Note that when the inverter is run at the ambient temperature above 40°C with a 2kHz or higher value set in Pr. 72, the rated output current of the inverter must be reduced. (Refer to page 149.)
2. An increased PWM frequency will decrease motor noise but noise and leakage current will increase. Take proper action (Refer to pages 37 to 41).

## 4.2.23 Reset selection/disconnected PU detection/PU stop selection (Pr. 75)





### Pr. 75 "reset selection/disconnected PU detection/PU stop selection"

You can select the reset selection, disconnected PU (FR-PU04) detection function and PU stop selection function.

- Reset selection : You can select the reset function input timing.
- PU disconnection detection : When it is detected that the PU (FR-PU04) is disconnected from the inverter for more than 1 second, the inverter outputs an alarm code (E.PUE) and comes to an alarm stop.
- PU stop selection : When an alarm occurs in any operation mode, you can stop the inverter from the PU by pressing the  key.


Parameter Number	Factory Setting	Setting Range
75	14	0 to 3, 14 to 17

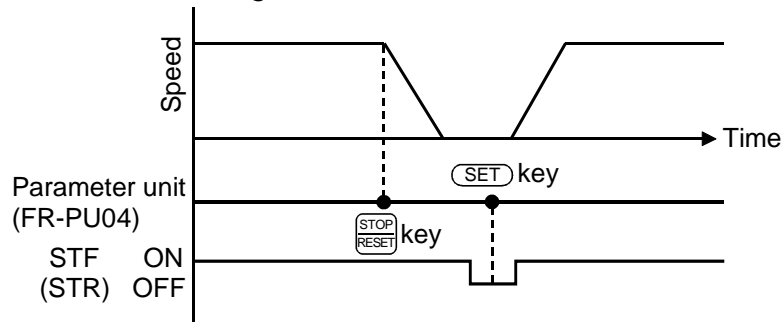
### <Setting>

Pr. 75 Setting	Reset Selection	PU Disconnection Detection	PU Stop Selection
0	Reset input normally enabled.	If the PU is disconnected, operation will be continued.	Pressing the  key decelerates the inverter to a stop only in the PU operation mode.
1	Reset input enabled only when the protective function is activated.		
2	Reset input normally enabled.	When the PU is disconnected, an error is displayed on the PU and the inverter output is shut off.	Pressing the  key decelerates the inverter to a stop in any of the PU and DeviceNet operation modes.
3	Reset input enabled only when the protective function is activated.		
14	Reset input normally enabled.	If the PU is disconnected, operation will be continued.	Pressing the  key decelerates the inverter to a stop in any of the PU and DeviceNet operation modes.
15	Reset input enabled only when the protective function is activated.		
16	Reset input normally enabled.	When the PU is disconnected, an error is displayed on the PU and the inverter output is shut off.	Pressing the  key decelerates the inverter to a stop in any of the PU and DeviceNet operation modes.
17	Reset input enabled only when the protective function is activated.		

## How to make a restart after a stop by the key on the PU

### Parameter unit (FR-PU04)

- 1) After completion of deceleration to a stop, switch off the STF or STR signal.
- 2) Press the  key.
- 3) Switch on the STF or STR signal.



Stop and restart example for DeviceNet operation

The other way of making a restart other than the above method is to perform a power-reset or to make a reset with the inverter reset terminal.

- Note:
1. By entering the reset signal (RES) during operation, the inverter shuts off output while it is reset, the data of the electronic overcurrent protection and regenerative brake duty are reset, and the motor coasts.
  2. The PU disconnection detection function judges that the PU is disconnected when it is removed from the inverter for more than 1 second. If the PU had been disconnected before power-on, it is not judged as an alarm.
  3. To resume operation, reset the inverter after confirming that the PU is connected securely.
  4. The Pr. 75 value can be set any time. Also, if parameter (all) clear is executed, this setting will not return to the initial value.
  5. When the inverter is stopped by the PU stop function, PS is displayed but an alarm is not output.
- When the PU connector is used for RS-485 communication operation, the reset selection and PU stop selection functions are valid but the PU disconnection detection function is invalid.

### CAUTION

-  **Do not reset the inverter with the start signal on. Otherwise, the motor will start instantly after resetting, leading to potentially hazardous conditions.**



#### 4.2.24 Parameter write inhibit selection (Pr. 77)

##### Pr. 77 "parameter write disable selection"

##### Related parameters

Pr. 79 "operation mode selection"

You can select between write-enable and disable for parameters. This function is used to prevent parameter values from being rewritten by incorrect operation.

Parameter Number	Factory Setting	Setting Range
77	0	0, 2

##### <Setting>

Pr. 77 Setting	Function
0	Parameter values may only be written while the inverter is at a stop in the PU or DeviceNet operation mode. (Note 1)
2	Write enabled even while the inverter is running.

Note: 1. The parameters half-tone screened in the parameter list can be set at any time.

2. If Pr. 77 = 2, the values of Pr. 23, Pr. 66, Pr. 71, Pr. 79, Pr. 80, Pr. 83, Pr. 84, Pr. 96, Pr. 180 to Pr.183 and Pr. 190 to Pr. 192 cannot be written during operation. Stop operation when changing their parameter settings.

3. When the parameter unit (FR-PU04) is used, setting "1" in Pr. 77 can inhibit parameter write. At this time, values may be written to Pr. 75, Pr. 77 and Pr. 79.  
Parameter clear and parameter all clear are also be inhibited.

#### 4.2.25 Reverse rotation prevention selection (Pr. 78)

##### Pr. 78 "reverse rotation prevention selection"

##### Related parameters

Pr. 79 "operation mode selection"

This function can prevent any reverse rotation fault resulting from the incorrect input of the start signal.

- Used for a machine which runs only in one direction, e.g. fan, pump.  
(The setting of this function is valid for the PU and DeviceNet operations.)

Parameter Number	Factory Setting	Setting Range
78	0	0, 1, 2

##### <Setting>

Pr. 78 Setting	Function
0	Both forward and reverse rotations allowed
1	Reverse rotation disallowed
2	Forward rotation disallowed

## 4.2.26 Operation mode selection (Pr. 79)

### Pr. 79 "operation mode selection"

Used to select the operation mode of the inverter. The inverter can be run from the parameter unit (PU operation) and DeviceNet signals (DeviceNet operation).

When power is switched on (factory setting), the DeviceNet operation mode is selected.

#### Related parameters

Pr. 4 to Pr. 6, Pr. 24 to Pr. 27,  
Pr. 232 to Pr. 239  
(multi-speed operation)  
Pr. 180 to Pr. 183  
(input terminal (DeviceNet  
input) function selection)

Parameter Number	Factory Setting	Setting Range
79	2	0 to 2

### <Setting>

In the following table, operation using the parameter unit is abbreviated to PU operation.

Pr. 79 Setting	Function		
0	When power is switched on, the DeviceNet operation mode is selected. PU or DeviceNet operation can be selected by pressing the <input type="button" value="PU"/> / <input type="button" value="EXT"/> keys of the parameter unit. For these modes, refer to the setting 1 and 2 below.		
1	<b>Operation mode</b>	<b>Running frequency</b>	<b>Start signal</b>
	PU operation mode (PU)	Digital setting by the key operation of parameter unit	<input type="button" value="FWD"/> or <input type="button" value="REV"/> key of parameter unit
2	DeviceNet operation mode (NET)	DeviceNet master unit	

## 4.2.27 General-purpose magnetic flux vector control selection (Pr. 80)

### Pr. 80 "motor capacity"

#### Related parameters

Pr. 71 "applied motor"  
 Pr. 83 "rated motor voltage"  
 Pr. 84 "rated motor frequency"  
 Pr. 96 "auto-tuning setting/status"

You can set the general-purpose magnetic flux vector control.

- General-purpose magnetic flux vector control

Provides large starting torque and sufficient low-speed torque.

If the motor constants vary slightly, stable, large low-speed torque is provided without specific motor constant setting or tuning.

Parameter Number	Factory Setting	Setting Range	Remarks
80	9999	0.1kW to 7.5kW, 9999	9999: V/F control

If any of the following conditions are not satisfied, faults such as torque shortage and speed fluctuation may occur. In this case, select V/F control.

### <Operating conditions>

- The motor capacity is equal to or one rank lower than the inverter capacity.
- The number of motor poles is any of 2, 4, and 6. (4 poles only for the constant-torque motor)
- Single-motor operation (one motor for one inverter) is performed.
- The wiring length between the inverter and motor is within 30m. (If the length is over 30m, perform offline auto tuning with the cables wired.)

### <Setting>

#### (1) General-purpose magnetic flux vector control

- The general-purpose magnetic flux vector control can be selected by setting the capacity of the motor used in Pr. 80.

Parameter Number	Setting	Description	
80	9999	V/F control	
	0.1 to 7.5	Set the motor capacity applied.	General-purpose magnetic flux vector control

- When using Mitsubishi's constant-torque motor (SF-JRCA), set "1" in Pr. 71. (When using the SF-JRC, perform the offline auto tuning .)

**4.2.28 Offline auto tuning function (Pr. 82 to Pr. 84, Pr. 90, Pr. 96)**

**Pr. 82 "motor exciting current"**

**Pr. 83 "rated motor voltage"**

**Pr. 84 "rated motor frequency"**

**Pr. 90 "motor constant (R1)"**

**Pr. 96 "auto-tuning setting/status"**

**Related parameters**

- Pr. 7 "acceleration time"
- Pr. 9 "electronic thermal O/L relay"
- Pr. 71 "applied motor"
- Pr. 79 "operation mode selection"
- Pr. 80 "motor capacity"

What is auto tuning?

- (1) The general-purpose magnetic flux vector control system gets the best performance from the motor for operation.
- (2) Using the offline auto tuning function to improve the operational performance of the motor.

When you use the general-purpose magnetic flux vector control, you can perform the offline auto tuning operation to calculate the motor constants automatically.

- Offline auto tuning is made valid only when Pr. 80 is set to other than "9999" to select the general-purpose magnetic flux vector control.
- The Mitsubishi standard motor (SF-JR0.4kW or more) or Mitsubishi constant-torque motor (By SF-JRCA 200V class and 4-pole motor of 0.4kW to 7.5kW) allows general-purpose magnetic flux vector control operation to be performed without using the offline auto tuning function. However, if any other motor (Motor made of the other manufacturers or SF-JRC, etc.) is used or the wiring distance is long, using the offline auto tuning function allows the motor to be operated with the optimum operational characteristics.
- Offline auto tuning
  - Automatically measures the motor constants used for general-purpose magnetic flux vector control.
  - Offline auto tuning can be performed with the load connected. (As the load is smaller, tuning accuracy is higher. Tuning accuracy does not change if inertia is large.)
  - The offline auto tuning status can be monitored with the PU (FR-PU04).
  - Offline auto tuning is available only when the motor is at a stop.
- Tuning data (motor constants) can be copied to another inverter with the PU (FR-PU04).
  - You can read, write and copy the motor constants tuned by the offline auto tuning.

Parameter Number	Factory Setting	Setting Range	Remarks
82	9999	0 to 500A, 9999	9999: Mitsubishi standard motor
83	200V	0 to 1000V	Rated inverter voltage
84	60Hz	50 to 120Hz	
90	9999	0 to 50Ω, 9999	9999: Mitsubishi standard motor
96	0	0, 1	0: No tuning

**<Operating conditions>**

- The motor is connected.
- The motor capacity is equal to or one rank lower than the inverter capacity.
- Special motors such as high-slip motors and high-speed motors cannot be tuned.
- The motor may move slightly. Therefore, fix the motor securely with a mechanical brake, or before tuning, make sure that there will be no problem in safety if the motor runs.

\*This instruction must be followed especially for vertical lift applications.

If the motor runs slightly, tuning performance is unaffected.

- Offline auto tuning will not be performed properly if it is started when a reactor is connected between the inverter and motor. Remove it before starting tuning.

**<Setting>****(1) Parameter setting**

- Set the motor capacity (kW) in Pr. 80 and select the general-purpose magnetic flux vector control.
- Refer to the parameter details list and set the following parameters:
  - 1) Set "1" in Pr. 96.
  - 2) Set the rated motor current (A) in Pr. 9.
  - 3) Set the rated motor voltage (V) in Pr. 83.
  - 4) Set the rated motor frequency (Hz) in Pr. 84.
  - 5) Select the motor using Pr. 71.
    - Standard motor ..... Pr. 71 = "3" or "103"
    - Constant-torque motor ..... Pr. 71 = "13" or "113"
    - Mitsubishi standard motor SF-JR 4 poles (1.5kW or less). Pr. 71 = "23" or "123"

Note: Pr. 83 and Pr. 84 are only displayed when the general-purpose magnetic flux vector control is selected.

In these parameters, set the values given on the motor plate. Set 200V/60Hz if the standard or other motor has more than one rated value.

After tuning is over, set the Pr. 9 "electronic overcurrent protection" value to the rated current at the operating voltage/frequency.

■ **Parameter details**

Parameter Number	Setting	Description		
9	0 to 500A	Set the rated motor current (A).		
71 (Note)	0, 100	Thermal characteristics suitable for standard motor		
	1, 101	Thermal characteristics suitable for Mitsubishi's constant-torque motor		
	3, 103	Standard motor	Select "offline auto tuning setting"	
	13, 113	Constant-torque motor		
	23, 123	Mitsubishi's SF-JR4P standard motor (1.5kW or less)		
	5, 105	Standard motor	Star connection	Direct input of motor constants enabled
	15, 115	Constant-torque motor		
	6, 106	Standard motor	Delta connection	
16, 116	Constant-torque motor			
83	0 to 1000V	Set the rated motor voltage (V).		
84	50 to 120Hz	Set the rated motor frequency (Hz).		
90	0 to 50Ω, 9999	Tuning data (Values measured by offline auto tuning are set automatically.)		
96	0	Offline auto tuning is not performed.		
	1	Offline auto tuning is performed.		

Note: The electronic overcurrent protection characteristics are also selected simultaneously. By setting any of "100 to 123", the electronic overcurrent protection changes to the thermal characteristic of the constant-torque motor when the RT signal switches on.

**(2) Tuning execution**

- For PU operation, press the **FWD** or **REV** key of the PU.
- For DeviceNet operation, switch on the run command.

Note: 1. To force tuning to end

- Switch on the MRS or RES signal or press the **STOP/RESET** key to end of the PU.
- Switch off the tuning start command to make a forced end.

2. During offline auto tuning, only the following I/O signals are valid:

- Input signals  
<Valid signals>  
MRS, RES, STF, STR
- Output signals  
RUN, A, B, C

3. Special caution should be exercised when a sequence has been designed to open the mechanical brake with the RUN signal.

### **(3) Monitoring the offline tuning status**

- For confirmation on the DeviceNet master unit, check the Pr. 96 setting.  
1: setting, 2: tuning in progress, 3: completion, 8: forced end, 9: error-activated end
- When the parameter unit (FR-PU04) is used, the Pr. 96 value is displayed during tuning on the main monitor as shown below:
- Parameter unit (FR-PU04) main monitor

(For inverter trip)

	1. Setting	2. Tuning in progress	3. Completion	4. Error-activated end
Display	1 ---STOP PU	TUNE 2 STF FWD PU	TUNE 3 COMPLETION STF STOP PU	TUNE 9 ERROR STF STOP PU


- Reference: Offline auto tuning time (factory setting) is about 10 seconds.

### **(4) Ending the offline auto tuning**

1) Confirm the Pr. 96 value.

- Normal end: "3" is displayed.
- Abnormal end: "9", "91", "92" or "93" is displayed.
- Forced end: "8" is displayed.

2) When tuning ended normally

For PU operation, press the  key of the PU. For DeviceNet operation, switch off the start signal (STF or STR) once.

This operation resets the offline auto tuning and the PU's monitor display returns to the ordinary indication. (Without this operation, next operation cannot be done.)

3) When tuning was ended due to an error

Offline auto tuning did not end normally. (The motor constants have not been set.)


Reset the inverter and start tuning all over again.

4) Error display definitions

<b>Error Display</b>	<b>Error Cause</b>	<b>Remedy</b>
9	Inverter trip	Make setting again.
91	Current limit (stall prevention) function was activated.	Increase acceleration/deceleration time. Set "1" in Pr. 156.
92	Converter output voltage reached 75% of rated value.	Check for fluctuation of power supply voltage.
93	Calculation error	Check the motor wiring and make setting again.

No connection with motor will result in a calculation (93) error.

5) When tuning was forced to end

A forced end occurs when you forced the tuning to end during tuning by switching off the start signal (STF or STR) once in DeviceNet operation or by pressing the  key in PU operation.


In this case, the offline auto tuning has not ended normally.

(The motor constants are not set.)

Reset the inverter and restart the tuning.

- Note: 1. The R1 motor constant measured during in the offline auto tuning is stored as a parameter and its data is held until the offline auto tuning is performed again.
2. An instantaneous power failure occurring during tuning will result in a tuning error.  
After power is restored, the inverter goes into the ordinary operation mode. Therefore, when STF (STR) is on, the motor runs in forward (reverse) rotation.
3. Any alarm occurring during tuning is handled as in the ordinary mode. Note that if an error retry has been set, retry is ignored.
4. The set frequency monitor displayed during the offline auto tuning is 0Hz.

 **CAUTION**

 **When the offline auto tuning is used in vertical lift application, e.g. a lifter, it may drop due to insufficient torque.**



**<Setting the motor constant as desired>**

- To set the motor constant without using the offline auto tuning data

**<Operating procedure>**

1. Set any of the following values in Pr. 71:

		<b>Star Connection Motor</b>	<b>Delta Connection Motor</b>
Setting	Standard motor	5 or 105	6 or 106
	Constant-torque motor	15 or 115	16 or 116

By setting any of "105 to 116", the electronic overcurrent protection changes to the thermal characteristics of the constant-torque motor when the RT signal switches on.

2. Set "801" in Pr. 77.

(Only when the Pr. 80 setting is other than "9999", the parameter values of the motor exciting current (Pr. 82) and motor constant (Pr. 90) can be displayed. Though the parameter values other than Pr. 82 and Pr. 90 can also be displayed, they are parameters for manufacturer setting and shall not be changed.)

3. In the parameter setting mode, read the following parameters and set desired values:

<b>Parameter Number</b>	<b>Name</b>	<b>Setting Range</b>	<b>Setting Increments</b>	<b>Factory Setting</b>
82	Motor exciting current	0 to 500A, 9999	0.01A	9999
90	Motor constant (R1)	0 to 10Ω, 9999	0.001Ω	9999

4. Return the Pr. 77 setting to the original value.

5. Refer to the following table and set Pr. 84:

<b>Parameter Number</b>	<b>Name</b>	<b>Setting Range</b>	<b>Setting Increments</b>	<b>Factory Setting</b>
84	Rated motor frequency	50 to 120Hz	0.01Hz	60Hz

Note:1. The Pr. 90 value may only be read when general-purpose magnetic flux vector control has been selected.

2. Set "9999" in Pr. 90 to use the standard motor constant (including that for the constant-torque motor).
3. If "star connection" is mistaken for "delta connection" or vice versa during setting of Pr. 71, general-purpose magnetic flux vector control cannot be exercised normally.

## 4.2.29 Computer link operation (Pr. 117 to Pr. 124)

**Pr. 117 "station number"**

**Pr. 118 "communication speed"**

**Pr. 119 "stop bit length"**

**Pr. 120 "parity check presence/absence"**

**Pr. 121 "number of communication retries"**

**Pr. 122 "communication check time interval"**

**Pr. 123 "waiting time setting"**

**Pr. 124 "CR • LF presence/absence selection"**

Used to perform required settings for RS-485 communication between the inverter and personal computer.

- **The motor can be run from the PU connector of the inverter using RS-485 communication.**

Communication specifications

Conforming standard		RS-485	
Number of inverters connected		1:N (maximum 32 inverters)	
Communication speed		Selectable between 19200, 9600 and 4800bps	
Control protocol		Asynchronous	
Communication method		Half-duplex	
Communication specifications	Character system	ASCII (7 bits/8 bits) selectable	
	Stop bit length	Selectable between 1 bit and 2 bits.	
	Terminator	CR/LF (presence/absence selectable)	
	Check system	Parity check	Selectable between presence (even/odd) and absence
		Sum check	Present
Waiting time setting		Selectable between presence and absence	

- **For the data codes of the parameters, refer to Appendix 4 "Data Code List" (page 185).**

### REMARKS

For computer link operation, set 65520 (HFFF0) as the value "8888" and 65535 (HFFFF) as the value "9999".

Parameter Number	Factory Setting	Setting Range	
117	0	0 to 31	
118	192	48, 96, 192	
119	1	Data length 8	0, 1
		Data length 7	10, 11
120	2	0, 1, 2	
121	1	0 to 10, 9999	
122*	0	0, 0.1 to 999.8 s, 9999	
123	9999	0 to 150, 9999	
124	1	0, 1, 2	

- \* When making communication, set any value other than 0 in Pr. 122 "communication check time interval".

**<Setting>**

To make communication between the personal computer and inverter, the communication specifications must be set to the inverter initially. If initial setting is not made or there is a setting fault, data transfer cannot be made.

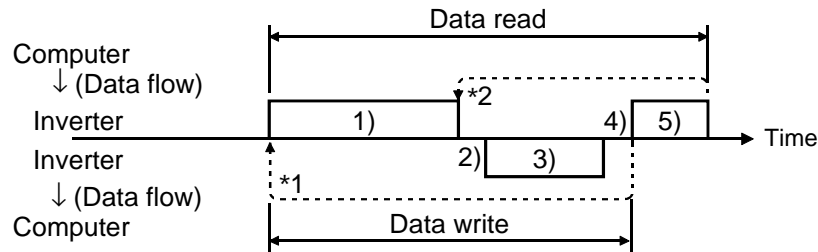
Note: After making the initial setting of the parameters, always reset the inverter. After you have changed the communication-related parameters, communication cannot be made until the inverter is reset.

Parameter Number	Description	Setting	Description	
117	Station number	0 to 31	Station number specified for communication from the PU connector. Set the inverter station numbers when two or more inverters are connected to one personal computer.	
118	Communication speed	48	4800bps	
		96	9600bps	
		192	19200bps	
119	Stop bit length	8 bits	0	Stop bit length 1 bit
			1	Stop bit length 2 bits
		7 bits	10	Stop bit length 1 bit
			11	Stop bit length 2 bits
120	Parity check presence/absence	0	Absent	
		1	Odd parity present	
		2	Even parity present	
121	Number of communication retries	0 to 10	Set the permissible number of retries at occurrence of a data receive error. If the number of consecutive errors exceeds the permissible value, the inverter will come to an alarm stop.	
		9999 (65535)	If a communication error occurs, the inverter will not come to an alarm stop. At this time, the inverter can be coasted to a stop by MRS or RES input. During a communication error (H0 to H5), the minor fault signal (LF) is switched on. Assign the used terminals with Pr. 192 "A, B, C terminal (ABC) function selection".	
122	Communication check time interval	0	No communication	
		0.1 to 999.8	Set the communication check time [seconds] interval. If a no-communication state persists for longer than the permissible time, the inverter will come to an alarm stop.	
		9999	Communication check suspension	
123	Waiting time setting	0 to 150	Set the waiting time between data transmission to the inverter and response.	
		9999	Set with communication data.	
124	CR • LF instruction presence/absence	0	Without CR/LF	
		1	With CR, without LF	
		2	With CR/LF	

<Computer programming>

**(1) Communication protocol**

Data communication between the computer and inverter is performed using the following procedure:



- \*1. If a data error is detected and a retry must be made, execute retry operation with the user program. The inverter comes to an alarm stop if the number of consecutive retries exceeds the parameter setting.
- \*2. On receipt of a data error occurrence, the inverter returns "reply data 3)" to the computer again. The inverter comes to an alarm stop if the number of consecutive data errors reaches or exceeds the parameter setting.

**(2) Communication operation presence/absence and data format types**

Communication operation presence/absence and data format types are as follows:

No.	Operation	Run Command	Running Frequency	Parameter Write	Inverter Reset	Monitoring	Parameter Read
1)	Communication request is sent to the inverter in accordance with the user program in the computer.	A'	A (A") Note 1	A (A") Note 2	A	B	B
2)	Inverter data processing time	Present	Present	Present	Absent	Present	Present
3)	Reply data from the inverter (Data 1) is checked for error.	No error* (Request accepted)	C	C	Absent	E, E' (E") Note 1	E (E") Note 2
		With error (request rejected)	D	D	Absent	F	F
4)	Computer processing delay time	Absent	Absent	Absent	Absent	Absent	Absent
5)	Answer from computer in response to reply data 3). (Data 3) is checked for error)	No error* (No inverter processing)	Absent	Absent	Absent	G	G
		With error (Inverter outputs 3) again)	Absent	Absent	Absent	Absent	H

\* In the communication request data from the computer to the inverter, 10ms or more is also required after "no data error (ACK)". (Refer to page 104.)

Note 1. When any of "0.01 to 9998" is set in Pr. 37 "speed display" and "1" in data code "HFF", the data format is always A" or E" regardless of the data code "HFF" setting. The output frequency is the value of the speed display and its unit is 0.001r/min. If the data code FF is not 1, the unit is 1r/min and the 4-digit data format can be used.

2. The read/write data format of Pr. 37 "speed display" is always E"/A".

**(3) Data format**

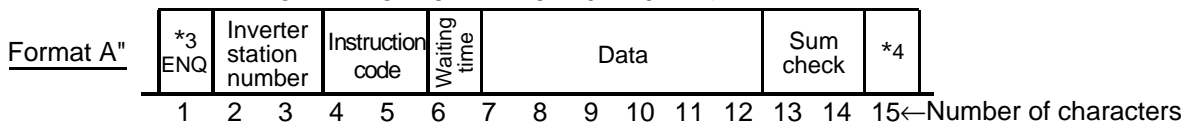
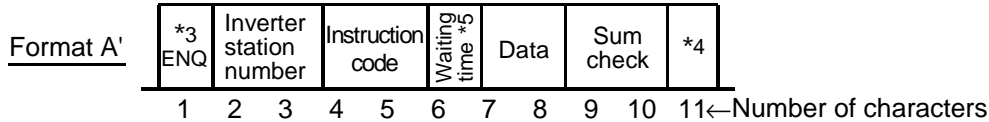
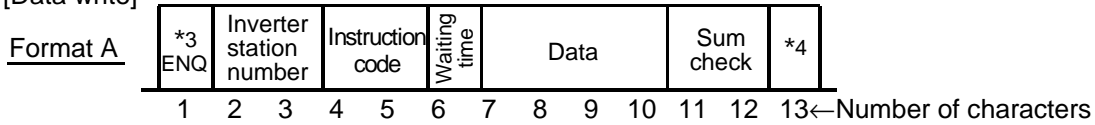
Data used is hexadecimal.

Data is automatically transferred in ASCII between the computer and inverter.

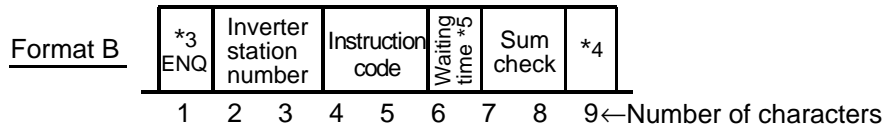
1) Data format types

(1) Communication request data from computer to inverter

[Data write]



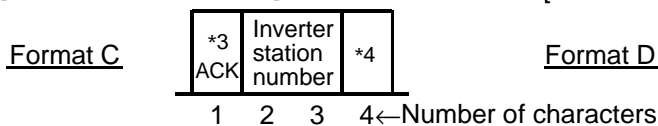
[Data read]



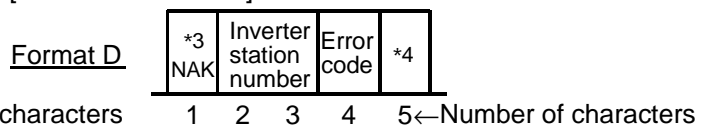
Note: 1. The inverter station numbers may be set between H00 and H1F (stations 0 and 31) in hexadecimal.  
 2. \*3 indicates the control code.  
 3. \*4 indicates the CR or LF code.  
 When data is transmitted from the computer to the inverter, codes CR (carriage return) and LF (line feed) are automatically set at the end of a data group on some computers. In this case, setting must also be made on the inverter according to the computer.  
 Also, the presence and absence of the CR and LF codes can be selected using Pr. 124.  
 4. At \*5, when Pr. 123 "waiting time setting" ≠ 9999, create the communication request data without "waiting time" in the data format.  
 (The number of characters is decremented by 1.)

2) Reply data from inverter to computer during data write

[No data error detected]



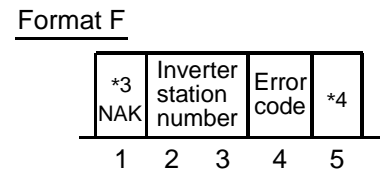
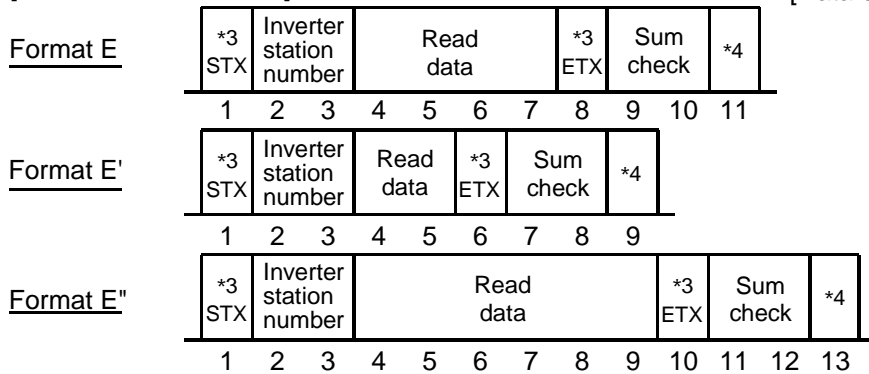
[Data error detected]



3) Reply data from inverter to computer during data read

[No data error detected]

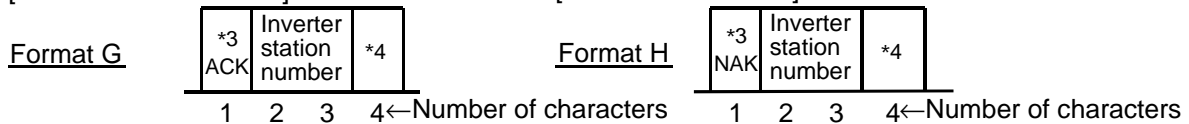
[Data error detected]



4) Send data from computer to inverter during data read

[No data error detected]

[Data error detected]



**(4) Data definitions**

1) Control codes

Signal	ASCII Code	Description
STX	H02	Start of Text (Start of data)
ETX	H03	End of Text (End of data)
ENQ	H05	Enquiry (Communication request)
ACK	H06	Acknowledge (No data error detected)
LF	H0A	Line Feed
CR	H0D	Carriage Return
NAK	H15	Negative Acknowledge (Data error detected)

2) Inverter station number

Specify the station number of the inverter which communicates with the computer.

3) Instruction code

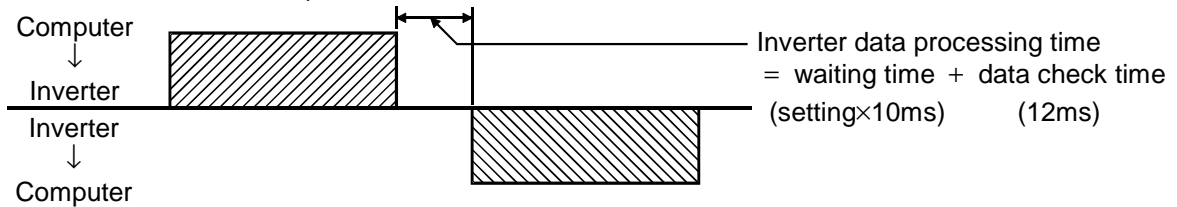
Specify the processing request, e.g. operation, monitoring, given by the computer to the inverter. Hence, the inverter can be run and monitored in various ways by specifying the instruction code as appropriate. (Refer to page 185.)

4) Data

Indicates the data such as frequency and parameters transferred to and from the inverter. The definitions and ranges of set data are determined in accordance with the instruction codes. (Refer to page 185.)

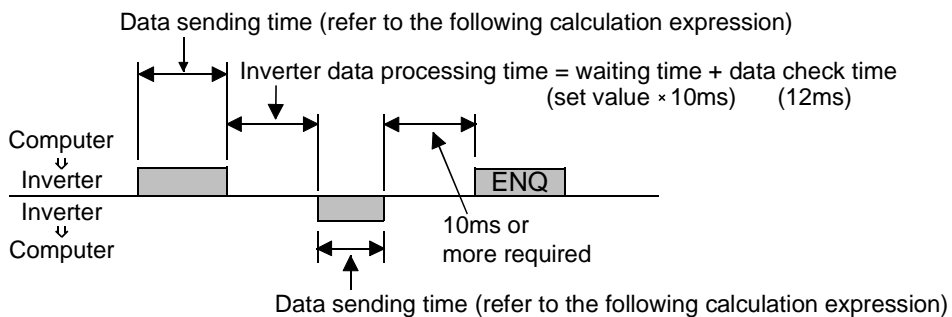
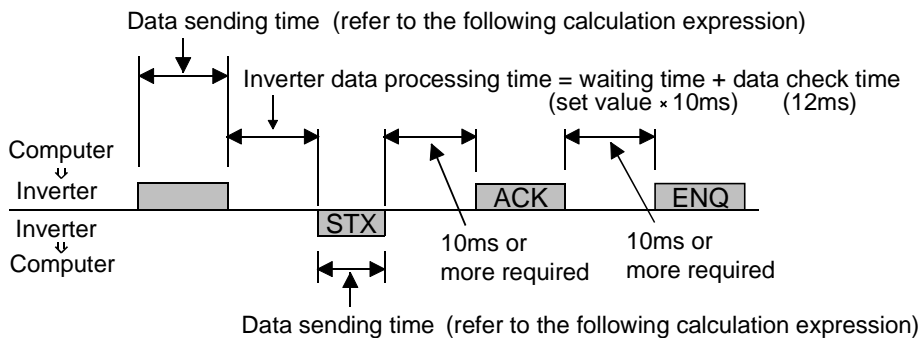
5) Waiting time

Specify the waiting time between the receipt of data at the inverter from the computer and the transmission of reply data. Set the waiting time in accordance with the response time of the computer between 0 and 150ms in 10ms increments (e.g. 1 = 10ms, 2 = 20ms).



Note: If the Pr. 123 "waiting time setting" value is not 9999, create the communication request data with no "waiting time" in the data format. (The number of characters is decremented by 1.)

6) Response time



[Data sending time calculation expression]

$$\frac{1}{\text{Communication speed (bps)}} \times \text{Number of data characters (Refer to page 102)} \times \text{Communication specification (Total number of bits) (See below)} = \text{Data sending time (s)}$$

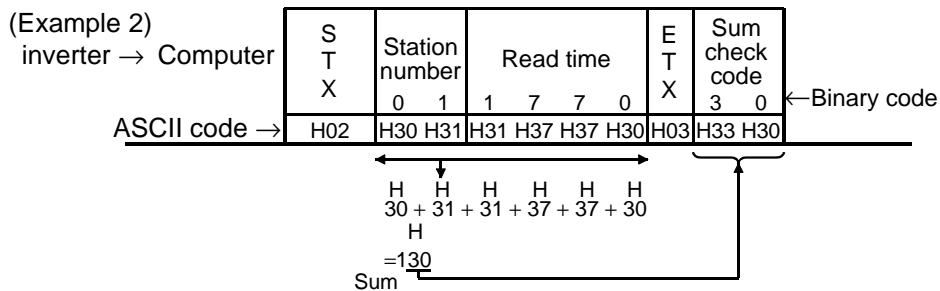
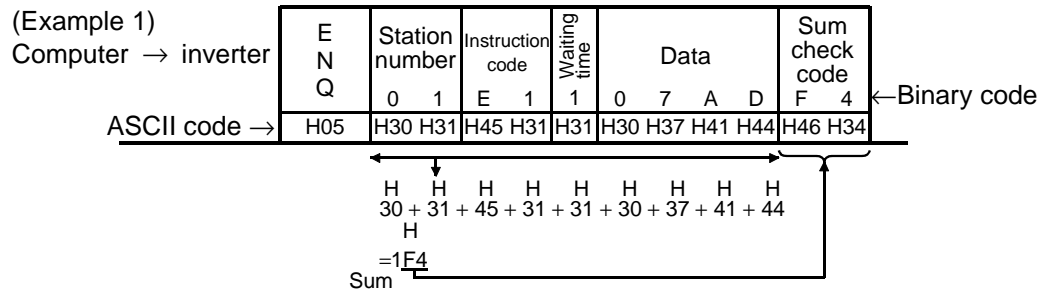
● Communication specification

Name		Number of Bits
Stop bit length		1 bit 2 bits
Data length		7 bits 8 bits
Parity check	Yes	1 bit
	No	0 bits

In addition to the bits in the above table, 1 bit is required for the start bit.  
 Minimum total number of bits ... 9 bits  
 Maximum total number of bits ... 12 bits

7) Sum check code

The sum check code is 2-digit ASCII (hexadecimal) representing the lower 1 byte (8 bits) of the sum (binary) derived from the checked ASCII data.



8) Error code




If any error is found in the data received by the inverter, its definition is sent back to the computer together with the NAK code. (Refer to page 110.)

- Note: 1. When the data from the computer has an error, the inverter will not accept that data.
2. Any data communication, e.g. run command, monitoring, is started when the computer gives a communication request. Without the computer's command, the inverter does not return any data. For monitoring, therefore, design the program to cause the computer to provide a data read request as required.
3. When accessing the parameter settings, data for link parameter expansion setting differs between the parameters as indicated below:

		Instruction Code	Data
Link parameter expansion setting	Read	H7F	H00: Pr. 0 to Pr. 96 values are accessible. H01: Pr. 100 to Pr. 156 values are accessible. H02: Pr. 160 to Pr. 196 and Pr. 232 to Pr. 250 values are accessible.
	Write	HFF	H03: Pr. 345 to Pr. 348 values are accessible. H09: Pr. 990, Pr. 991 values are accessible.



 **CAUTION**

-  **When the inverter's permissible communication time interval is not set, interlocks are provided to disable operation to prevent hazardous conditions. Always set the communication check time interval before starting operation.**
-  **Data communication is not started automatically but is made only once when the computer provides a communication request. If communication is disabled during operation due to signal cable breakage etc, the inverter cannot be stopped. When the communication check time interval has elapsed, the inverter will come to an alarm stop (E.PUE).  
The inverter can be coasted to a stop by switching on its RES signal or by switching power off.**
-  **If communication is broken due to signal cable breakage, computer fault etc, the inverter does not detect such a fault. This should be fully noted.**

**<Setting items and set data>**

After completion of parameter settings, set the instruction codes and data then start communication from the computer to allow various types of operation control and monitoring.

No.	Item	Instruction Code	Description	Number of Data Digits (Data code FF=1)																																																																																	
1	Operation mode	Read	H7B H0001: DeviceNet operation H0002: Communication operation	4 digits																																																																																	
		Write	HFB H0001: DeviceNet operation H0002: Communication operation																																																																																		
2	Monitoring	Output frequency [speed]	H6F H0000 to HFFFF: Output frequency (hexadecimal) in 0.01Hz increments [Speed (hexadecimal) in r/min increments if Pr. 37 = 1 to 9998]	4 digits (6 digits)																																																																																	
		Output current	H70 H0000 to HFFFF: Output current (hexadecimal) in 0.01A increments	4 digits																																																																																	
		Output voltage	H71 H0000 to HFFFF: Output voltage (hexadecimal) in 0.1V increments	4 digits																																																																																	
		Alarm definition	H74 to H77 H0000 to HFFFF: Two most recent alarm definitions Alarm definition display example (instruction code H74) <div style="text-align: center;"> <table border="1" style="margin: auto;"> <tr> <td style="text-align: center;">b15</td> <td style="text-align: center;">b8b7</td> <td style="text-align: center;">b0</td> </tr> <tr> <td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">1</td><td style="text-align: center;">1</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">1</td><td style="text-align: center;">0</td><td style="text-align: center;">1</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td> </tr> <tr> <td colspan="8" style="text-align: center;">Previous alarm (H30)</td> <td colspan="8" style="text-align: center;">Most recent alarm (HA0)</td> </tr> </table> </div> <table border="1" style="margin: auto;"> <thead> <tr> <th colspan="4">Alarm data</th> </tr> <tr> <th>Data</th> <th>Description</th> <th>Data</th> <th>Description</th> </tr> </thead> <tbody> <tr><td>H00</td><td>No alarm</td><td>H60</td><td>OLT</td></tr> <tr><td>H10</td><td>OC1</td><td>H70</td><td>BE</td></tr> <tr><td>H11</td><td>OC2</td><td>H80</td><td>GF</td></tr> <tr><td>H12</td><td>OC3</td><td>H81</td><td>LF</td></tr> <tr><td>H20</td><td>OV1</td><td>H90</td><td>OHT</td></tr> <tr><td>H21</td><td>OV2</td><td>HA0</td><td>OPT</td></tr> <tr><td>H22</td><td>OV3</td><td>HB0</td><td>PE</td></tr> <tr><td>H30</td><td>THT</td><td>HB1</td><td>PUE</td></tr> <tr><td>H31</td><td>THM</td><td>HB2</td><td>RET</td></tr> <tr><td>H40</td><td>FIN</td><td></td><td></td></tr> </tbody> </table>	b15	b8b7	b0	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	Previous alarm (H30)								Most recent alarm (HA0)								Alarm data				Data	Description	Data	Description	H00	No alarm	H60	OLT	H10	OC1	H70	BE	H11	OC2	H80	GF	H12	OC3	H81	LF	H20	OV1	H90	OHT	H21	OV2	HA0	OPT	H22	OV3	HB0	PE	H30	THT	HB1	PUE	H31	THM	HB2	RET	H40	FIN	
b15	b8b7	b0																																																																																			
0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0																																																																						
Previous alarm (H30)								Most recent alarm (HA0)																																																																													
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H00	No alarm	H60	OLT																																																																																		
H10	OC1	H70	BE																																																																																		
H11	OC2	H80	GF																																																																																		
H12	OC3	H81	LF																																																																																		
H20	OV1	H90	OHT																																																																																		
H21	OV2	HA0	OPT																																																																																		
H22	OV3	HB0	PE																																																																																		
H30	THT	HB1	PUE																																																																																		
H31	THM	HB2	RET																																																																																		
H40	FIN																																																																																				
3	Run command	HFA	<table border="1" style="margin: auto;"> <tr> <td style="text-align: center;">b7</td> <td style="text-align: center;">b0</td> </tr> <tr> <td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">0</td><td style="text-align: center;">1</td><td style="text-align: center;">0</td> </tr> </table> [For example 1] [Example 1] H02 ... Forward rotation [Example 2] H00 ... Stop	b7	b0	0	0	0	0	0	0	1	0	2 digits																																																																							
b7	b0																																																																																				
0	0	0	0	0	0	1	0																																																																														

No.	Item	Instruction Code	Description	Number of Data Digits (Data code FF=1)												
4	Inverter status monitor	H7A	<table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: right;">b7</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="text-align: left;">b0</td> </tr> </table> <p>(For example 1)                      [Example 1] H02 ... During forward rotation                      [Example 2] H80 ... Stop due to alarm</p> <p>b0: Inverter running (RUN)                      b1: Forward rotation                      b2: Reverse rotation                      b3: Up to frequency (SU)                      b4: Overload (OL)                      b5: _____                      b6: Frequency detection (FU)                      b7: Alarm occurrence</p>	b7	0	0	0	0	0	0	1	0	b0	2 digits		
b7	0	0	0	0	0	0	1	0	b0							
5	Set frequency read (E <sup>2</sup> PROM)	H6E	Reads the set frequency (RAM or E <sup>2</sup> PROM). H0000 to H9C40: 0.01Hz increments (hexadecimal)	4 digits (6 digits)												
	Set frequency read (RAM)	H6D														
	Set frequency write (E <sup>2</sup> PROM)	HEE	H0000 to H9C40: 0.01Hz increments (hexadecimal) (0 to 400.00Hz)	4 digits (6 digits)												
	Set frequency write (RAM)	HED	To change the set frequency consecutively, write data to the inverter RAM. (Instruction code: HED)													
6	Inverter reset	HFD	H9696: Resets the inverter. As the inverter is reset on start of communication by the computer, the inverter cannot send reply data back to the computer.	4 digits												
7	Alarm definition batch clear	HF4	H9696: Batch clear of alarm history	4 digits												
8	All parameter clear	HFC	<p>All parameters return to the factory settings. Any of two different all clear operations is performed according to the data.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Pr. Data</th> <th style="text-align: center;">Communi- cation Pr.</th> <th style="text-align: center;">Other Pr.*</th> <th style="text-align: center;">HFF</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">H9696</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> <tr> <td style="text-align: center;">H9966</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> <td style="text-align: center;">○</td> </tr> </tbody> </table> <p>When all parameter clear is executed for H9696 or H9966, communication-related parameter settings also return to the factory settings. When resuming operation, set the parameters again.                      * Pr. 75 is not cleared.</p>	Pr. Data	Communi- cation Pr.	Other Pr.*	HFF	H9696	○	○	○	H9966	○	○	○	4 digits
Pr. Data	Communi- cation Pr.	Other Pr.*	HFF													
H9696	○	○	○													
H9966	○	○	○													
9	Parameter write	H80 to HFD	Refer to the "Data Code List" (page 185) and write and/or read the values as required.	4 digits												
10	Parameter read	H00 to H7B														

**PARAMETERS**

No.	Item	Instruction Code	Description	Number of Data Digits (Data code FF=1)	
11	Link parameter expansion setting	Read	H7F	H00 to H6C and H80 to HEC parameter values are changed. H00: Pr. 0 to Pr. 96 values are accessible. H01: Pr. 117 to Pr. 156 values are accessible. H02: Pr. 160 to Pr. 192 and Pr. 232 to Pr. 250 values are accessible. H03: Pr. 345 to Pr. 348 values are accessible. H09: Pr. 990, Pr. 991 values are accessible.	2 digits
		Write	HFF		

**REMARKS**

For the instruction codes HFF, their set values are held once they are written, but changed to 0 when the inverter is reset or all clear is performed.

**<Error Code List>**

The corresponding error code in the following list is displayed if an error is detected in any communication request data from the computer:

Error Code	Item	Definition	Inverter Operation
H0	Computer NAK error	The number of errors consecutively detected in communication request data from the computer is greater than allowed number of retries.	Brought to an alarm stop (E.PUE) if error occurs continuously more than the allowable number of retries.
H1	Parity error	The parity check result does not match the specified parity.	
H2	Sum check error	The sum check code in the computer does not match that of the data received by the inverter.	
H3	Protocol error	Data received by the inverter is in wrong protocol, data receive is not completed within given time, or CR and LF are not as set in the parameter.	
H4	Framing error	The stop bit length is not as specified by initialization.	
H5	Overrun error	New data has been sent by the computer before the inverter completes receiving the preceding data.	
H6	_____	_____	_____
H7	Character error	The character received is invalid (other than 0 to 9, A to F, control code).	Does not accept received data but is not brought to alarm stop.
H8	_____	_____	_____
H9	_____	_____	_____
HA	Mode error	Parameter write was attempted in other than the computer link operation mode or during inverter operation.	Does not accept received data but is not brought to alarm stop.
HB	Instruction code error	The specified command does not exist.	
HC	Data range error	Invalid data has been specified for parameter write, frequency setting, etc.	
HD	_____	_____	_____
HE	_____	_____	_____
HF	_____	_____	_____

**(5) Communication specifications for RS-485 communication**

Operation Location	Item	Operation Mode
		Communication Operation from PU Connector
Computer user program via PU connector	Run command (start)	Enable
	Running frequency setting	Enable
	Monitoring	Enable
	Parameter write	Enable (*2)
	Parameter read	Enable
	Inverter reset	Enable
	Stop command (*1)	Enable
Control circuit terminal	Inverter reset	Enable
	Run command	Disable
	Running frequency setting	Disable

\*1 As set in Pr. 75.

\*2 As set in Pr. 77.

Note: At occurrence of RS-485 communication fault, the inverter cannot be reset from the computer.

**(6) Operation at alarm occurrence**

Fault Location	Description		Operation Mode
			Communication Operation (PU connector)
Inverter fault	Inverter operation		Stop
	Communication	PU connector	Continued
Communication error (Communication from PU connector)	Inverter operation		Stop/continued (*3)
	Communication	PU connector	Stop

\*3: Can be selected using the corresponding parameter (factory-set to stop).

**(7) Communication error**

Fault Location	Error Message	Remarks
Communication error (Communication from PU connector)	Not displayed	Error code is E.PUE

## 4.2.30 Settings for connection of FR-PU04 (Pr. 145, Pr. 990, Pr. 991)

### Pr. 145 "Parameter unit display language selection"

### Pr. 990 "Buzzer beep control"

### Pr. 991 "LCD contrast"

- All of the below parameters are only applicable when using the FR-PU04 parameter unit.

By setting the Pr. 145 "Parameter unit display language selection" value, you can select the language displayed on the parameter unit.


Pr. 145 Setting	Display Language
0	Japanese (factory setting)
1	English
2	German
3	French
4	Spanish
5	Italian
6	Swedish
7	Finnish

By setting the Pr. 990 "Buzzer beep control" value, you can select whether the "beep" is sounded or not when you press any of the parameter unit key.

Pr. 990 Setting	Description
0	No sound
1	Sound generated (factory setting)

By setting the Pr. 991 "LCD contrast" value, you can adjust the contrast of the parameter unit LCD.

Pr. 991 Setting	
0 to 63	

Note: The LCD contrast setting will not be stored until the  key is pressed.

### 4.2.31 Output current detection function (Pr. 150, Pr. 151)

**Pr. 150 "output current detection level"**

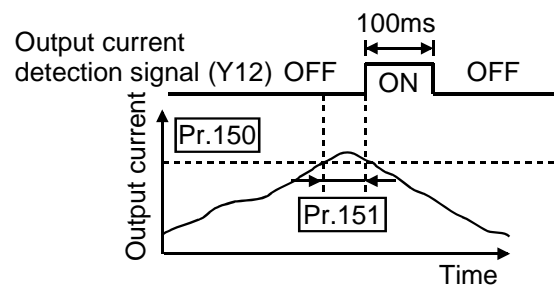
**Pr. 151 "output current detection period"**

**Related parameters**

Pr. 192  
"A, B, C terminal (ABC) function selection"

- If the output current remains higher than the Pr. 150 setting during inverter operation for longer than the time set in Pr. 151, the output current detection signal (Y12) is output.  
(Use Pr. 192 to assign the terminal used for Y12 signal output.)

Parameter Number	Factory Setting	Setting Range
150	150%	0 to 200.0%
151	0	0 to 10 s



**<Setting>**

Refer to the following list and set the parameters:

Parameter Number	Description
150	Set the output current detection level. 100% is the rated inverter current.
151	Set the output current detection time. Set a period of time from when the output current rises to or above the Pr. 150 setting to when the output current detection signal (Y12) is output.

Note: 1. The output current detection signal is held on for about 100ms (at least) if it switches on once when the output current rises to or above the preset detection level.  
 2. This function is also valid during execution of offline auto tuning.  
 3. When the terminal functions are changed using Pr. 192, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.



### 4.2.32 Zero current detection (Pr. 152, Pr. 153)

#### Pr. 152 "zero current detection level"

#### Pr. 153 "zero current detection period"

**Related parameters**  
Pr. 192 "A, B, C terminal function (ABC) selection"

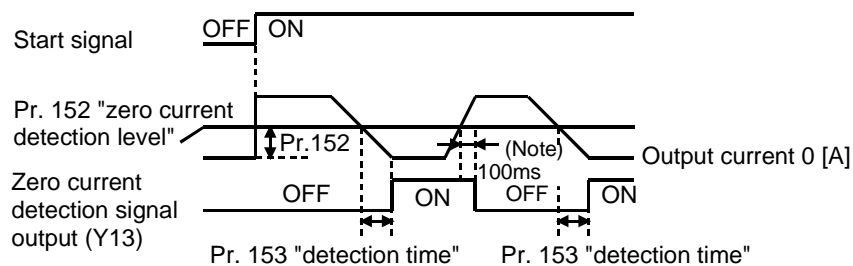
When the inverter's output current falls to "0", torque will not be generated. This may cause a gravity drop when the inverter is used in vertical lift application.

To prevent this, the output current "zero" signal can be output from the inverter to close the mechanical brake when the output current has fallen to "zero".

- If the output current remains lower than the Pr. 152 setting during inverter operation for longer than the time set in Pr. 153, the zero current detection (Y13) signal is output.

(Use Pr. 192 to assign the terminal used for Y13 signal output.)

Parameter Number	Factory Setting	Setting Range
152	5.0%	0 to 200.0%
153	0.5 s	0.05 to 1 s



#### <Setting>

Refer to the following list and set the parameters:

Parameter Number	Description
152	Set the zero current detection level. Set this parameter to define the percentage of the rated current at which the zero current will be detected.
153	Set the zero current detection time. Set a period of time from when the output current falls to or below the Pr. 152 setting to when the zero current detection signal (Y13) is output.

Note: 1. If the current falls below the preset detection level but the timing condition is not satisfied, the zero current detection signal is held on for about 100ms.  
2. This function is also valid during execution of offline auto tuning.  
3. When the terminal functions are changed using Pr. 192, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.

**⚠ CAUTION**

- ⚠ The zero current detection level setting should not be too high, and the zero current detection time setting should not be too long. Otherwise, the detection signal may not be output when torque is not generated at a low output current.
- ⚠ To prevent the machine and equipment from resulting in hazardous conditions by use of the zero current detection signal, install a safety backup such as an emergency brake.

**4.2.33 Stall prevention function and current limit function (Pr. 156)****Pr. 156 "stall prevention operation selection"****Related parameters**

- Pr. 22 "stall prevention operation level"
- Pr. 23 "stall prevention operation level compensation factor at double speed"

You can make settings to disable stall prevention caused by overcurrent and to disable the inverter from an overcurrent trip if an excessive current occurs due to sudden load variation or turning the inverter's output side ON-OFF (to disable the fast-response current limit which limits the current).

Parameter Number	Factory Setting	Setting Range
156	0	0 to 31, 100

<Setting>


Refer to the following tables and set the parameter as required.

Pr. 156 Setting	Fast-Response Current Limit ○: Activated ●: Not activated	Stall Prevention Operation Selection ○: Activated ●: Not activated			OL Signal Output ○: Operation continued ●: Operation not continued (Note 1)
		Acceleration	Constant speed	Deceleration	
0	○	○	○	○	○
1	●	○	○	○	○
2	○	●	○	○	○
3	●	●	○	○	○
4	○	○	●	○	○
5	●	○	●	○	○
6	○	●	●	○	○
7	●	●	●	○	○
8	○	○	○	●	○
9	●	○	○	●	○
10	○	●	○	●	○
11	●	●	○	●	○
12	○	○	●	●	○
13	●	○	●	●	○
14	○	●	●	●	○
15	●	●	●	●	○

Pr. 156 Setting	Fast-Response Current Limit ○: Activated ●: Not activated	Stall Prevention Operation Selection ○: Activated ●: Not activated			OL Signal Output ○: Operation continued ●: Operation not continued (Note 1)
		Acceleration	Constant speed	Deceleration	
16	○	○	○	○	●
17	●	○	○	○	●
18	○	●	○	○	●
19	●	●	○	○	●
20	○	○	●	○	●
21	●	○	●	○	●
22	○	●	●	○	●
23	●	●	●	○	●
24	○	○	○	●	●
25	●	○	○	●	●
26	○	●	○	●	●
27	●	●	○	●	●
28	○	○	●	●	●
29	●	○	●	●	●
30	○	●	●	●	●
31	●	●	●	●	●
100	Regenerative Driving	○	○	○	○
		●	●	●	○

Note 1: When "Operation not continued for OL signal output" is selected, the "E.OLT" alarm code (stopped by stall prevention) is displayed and operation stopped.  
 2: If the load is heavy, the lift is predetermined, or the acceleration/deceleration time is short, the stall prevention may be activated and the motor not stopped in the preset acceleration/deceleration time. Therefore, set optimum values to the Pr. 156 and stall prevention operation level.

 CAUTION

-  Always perform test operation.
- Stall prevention operation performed during acceleration may increase the acceleration time.
- Stall prevention operation performed during constant speed may cause sudden speed changes.
- Stall prevention operation performed during deceleration may increase the deceleration time, increasing the deceleration distance.

## 4.2.34 User group selection (Pr. 160, Pr. 173 to Pr. 176)

### Pr. 160 "user group read selection"

### Pr. 173 "user group 1 registration"

### Pr. 174 "user group 1 deletion"

### Pr. 175 "user group 2 registration"

### Pr. 176 "user group 2 deletion"

Among all parameters, a total of 32 parameters can be registered to two different user groups. The registered parameters may only be accessed.

The other parameters cannot be read.

Parameter Number	Factory Setting	Setting Range	Remarks
160	0	0, 1, 10, 11	
173	0	0 to 999	
174	0	0 to 999, 9999	9999: Batch deletion
175	0	0 to 999	
176	0	0 to 999, 9999	9999: Batch deletion

### <Examples of use>

#### (1) Registration of parameter to user group

Write the parameter numbers to be registered to Pr. 173 (User group 1 registration) or Pr. 175 (User group 2 registration). Write the parameter numbers one by one.

#### (2) Deletion of parameter from the user group

Write the parameter numbers to be deleted to Pr. 174 (User group 1 deletion) or Pr. 176 (User group 2 deletion). Write the parameter numbers one by one.

#### (3) Set the required value in Pr. 160 to make the user group or groups valid or invalid.

Pr. 160 Setting	Description
0	Previous parameters read
1	User group 1's parameters read
10	User group 2's parameters read
11	User group 1 and 2 parameters read

Note: 1. The Pr. 77, Pr. 160 and Pr. 991 values may always be read independently of the user group setting.

2. The Pr. 173 or Pr. 174 value read indicates the number of parameters registered to group 1, and the Pr. 175 or Pr. 176 value read indicates the number of parameters registered to group 2.

3. If "0" is set in the second digit of two-digit Pr. 160, it is not displayed. However, "0" is displayed when it is set in the first digit only.

4. When "9999" is set in Pr. 174 or Pr. 176, the parameters registered to the corresponding user group are batch-deleted.

### 4.2.35 Actual operation hour meter clear (Pr. 171)

#### Pr. 171 "actual operation hour meter clear"

Related parameter  
Pr. 52 "PU main display data selection"

You can clear the monitor (actual operation hour) value which is selected when Pr. 52 is "23".

Parameter Number	Factory Setting	Setting Range
171	0	0

#### <Setting>

Write "0" in the parameter to clear the actual operation hour.

**Pr. 173 to Pr. 176 → Refer to Pr. 160.**

### 4.2.36 Input terminal (DeviceNet input) function selection (Pr. 180 to Pr. 183)

#### Pr. 180 "(RL) function selection"

#### Pr. 181 "(RM) function selection"

#### Pr. 182 "(RH) function selection"

#### Pr. 183 "MRS terminal (MRS) function selection"

Use these parameters to select/change the input terminal (DeviceNet input) functions.

Parameter Number	Terminal (DeviceNet input) Symbol	Factory Setting	Factory-Set Terminal Function	Setting Range	Remarks
180	(RL)	0	Low-speed operation command (RL)	0 to 3, 6, 8, 18	DeviceNet input
181	(RM)	1	Middle-speed operation command (RM)	0 to 3, 6, 8, 18	
182	(RH)	2	High-speed operation command (RH)	0 to 3, 6, 8, 18	
183	MRS (MRS)	6	Output shut-off (MRS)	0 to 3, 6 to 8, 18	DeviceNet input, input terminal

**<Setting>**

Refer to the following list and set the parameters.

Setting	Signal Name	Function	Related Parameters
0	RL	Low-speed operation command	Pr. 4 to Pr. 6 Pr. 24 to Pr. 27 Pr. 232 to Pr. 239
1	RM	Middle-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239
2	RH	High-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239
3	RT	Second function selection	Pr. 44 to Pr. 48
6	MRS	Output shut-off terminal	
7	OH	External thermal relay input * The external thermal relay provided for overheat protection or the embedded temperature relay within the motor is activated to stop the inverter.	Only Pr.183 may be set. (Input terminal)
8	REX	15-speed selection (combination with three speeds of RL, RM, RH)	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239
18	X18	General-purpose magnetic flux vector-V/F switch-over (OFF: general-purpose magnetic flux vector control, ON: V/F control) (Note 3)	Pr. 80

\*: Activated when the relay contact "opens".

Note: 1. One function can be assigned to two or more terminals (DeviceNet input). In this case, the terminal (DeviceNet input) inputs are OR' ed.

2. The speed command priorities are higher in order of multi-speed setting (RH, RM, RL, REX).

3. When V/F control is selected using the V/F-general-purpose magnetic flux switch-over function, the secondary functions are also selected. During operation, you cannot switch between V/F and general-purpose magnetic flux. Should you switch between V/F and general-purpose magnetic flux, only the secondary functions are selected.

4. Functions are invalid if values other than the above are set to Pr. 180 to Pr. 183 (input terminal (DeviceNet input) function selection).

### 4.2.37 Output terminal (DeviceNet input) function selection (Pr. 190 to Pr. 192)

**Pr. 190 "(RUN) function selection"**

**Pr. 191 "(FU) function selection"**

**Pr. 192 "A, B, C terminal (ABC) function selection"**

You can change the functions of the contact output terminals (DeviceNet input). Inverter status is not returned. Refer to page 53 for details.

Parameter Number	Terminal (DeviceNet input) Symbol	Factory Setting	Factory-Set Terminal Function	Setting Range	Remarks
190	(RUN)	0	Inverter running	0 to 99	DeviceNet output
191	(FU)	4	Output frequency detection	0 to 99	
192	A, B, C (ABC)	99	Alarm output	0 to 99	DeviceNet output, contact output terminal

**<Setting>**

Refer to the following table and set the parameters:

Setting	Signal Name	Function	Operation	Related Parameters	DeviceNet output (Inverter status)
0	RUN	Inverter running	Output during operation when the inverter output frequency rises to or above the starting frequency.	—	0 Bit
1	SU	Up to frequency	Refer to Pr. 41 "up-to-frequency sensitivity". (Note 1)	Pr. 41	3 Bit
3	OL	Overload alarm	Output while stall prevention function is activated.	Pr. 22, Pr. 23, Pr. 66	4 Bit
4	FU	Output frequency detection	Refer to Pr. 42, Pr. 43 (output frequency detection).	Pr. 42, Pr. 43	6 Bit
11	RY	Inverter operation ready	Output when the inverter is ready to be started by switching the start signal on.	—	—
12	Y12	Output current detection	Refer to Pr. 150 and Pr. 151 (output current detection).	Pr. 150, Pr. 151	—
13	Y13	Zero current detection	Refer to Pr. 152 and Pr. 153 (zero current detection).	Pr. 152, Pr. 153	—
98	LF	Minor fault output	Output when a minor fault (fan failure or communication error warning) occurs.	Pr. 121, Pr. 244	—
99	ABC	Alarm output	Output when the inverter's protective function is activated to stop the output (major fault).	—	7 Bit

Use the contact output terminals for the shaded signals.

Note: 1. The same function may be set to more than one terminal (DeviceNet output).  
 2. Pr. 190 to Pr. 192 do not function if the values set are other than the above.

**Pr. 232 to Pr. 239 → Refer to Pr. 4.**

**Pr. 240 → Refer to Pr. 72.**

#### 4.2.38 Cooling fan operation selection (Pr. 244)

##### **Pr. 244 "cooling fan operation selection"**

You can control the operation of the cooling fan built in the inverter (whether there is a cooling fan or not depends on the models. Refer to the outline dimensional drawings (page 152)).

Parameter Number	Factory Setting	Setting Range
244	0	0, 1

##### **<Setting>**

Setting	Description
0	Operated at power on (independent of whether the inverter is running or at a stop).
1	Cooling fan on-off control valid (The cooling fan is always on while the inverter is running. During a stop, the inverter status is monitored and the fan switches on-off according to temperature.)

##### **<Reference>**

In either of the following cases, fan operation is regarded as faulty and the light fault (LF) signal is output. Use Pr. 192 "A, B, C terminal (ABC) function selection" to allocate the terminal used to output the LF signal.

1) Pr. 244 = "0"

When the fan comes to a stop with power on.

2) Pr. 244 = "1"

When the inverter is running and the fan stops during fan ON command or the fan starts during fan OFF command.

Note: When the terminal assignment is changed using Pr. 192, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.



### 4.2.39 Slip compensation (Pr. 245 to Pr. 247)

#### Pr. 245 "rated motor slip"

#### Pr. 246 "slip compensation response time constant"

#### Pr. 247 "constant-output region slip compensation selection"

The inverter output current may be used to assume motor slip to keep the motor speed constant.

Parameter Number	Factory Setting	Setting Range	Remarks
245	9999	0 to 50%, 9999	9999: No slip compensation
246	0.5	0.01 to 10 s	
247	9999	0, 9999	9999: Slip compensation made

#### <Setting>

$$\text{Rated slip} = \frac{\text{Synchronous speed at base frequency} - \text{rated speed}}{\text{Synchronous speed at base frequency}} \times 100[\%]$$

Parameter Number	Setting	Function
245	0 to 50%	Used to set the rated motor slip.
	9999	Slip compensation is not made.
246	0.01 to 10 s	Used to set the slip compensation response time. (Note)
247	0	Slip compensation is not made in the constant output range (frequency range above the frequency set in Pr. 3).
	9999	Slip compensation is made in the constant output range.

Note: When this value is made smaller, response will be faster.  
However, as load inertia is greater, a regenerative overvoltage (OVT) error is more liable to occur.

## 4.2.40 Ground fault detection at start (Pr. 249)

### Pr. 249 "ground fault detection at start"

You can select whether ground fault detection at start is made or not. Ground fault detection is made only immediately after the start signal is input to the inverter.

If a ground fault occurs during operation, the protective function is not activated.

Parameter Number	Factory Setting	Setting Range
249	0	0, 1

#### <Setting>

Setting	Description
0	Ground fault detection not made
1	Ground fault detection made

- Note: 1. Since detection is made at a start, an about 20ms output delay occurs at every start.
2. When a ground fault is detected with "1" set in Pr. 249, alarm output "E.GF" is detected and the output is shut off.
3. If the motor capacity is less than 0.1kW, ground fault protection may not be provided.

## 4.2.41 Stop selection (Pr. 250)

### Pr. 250 "stop selection"

#### Related parameters

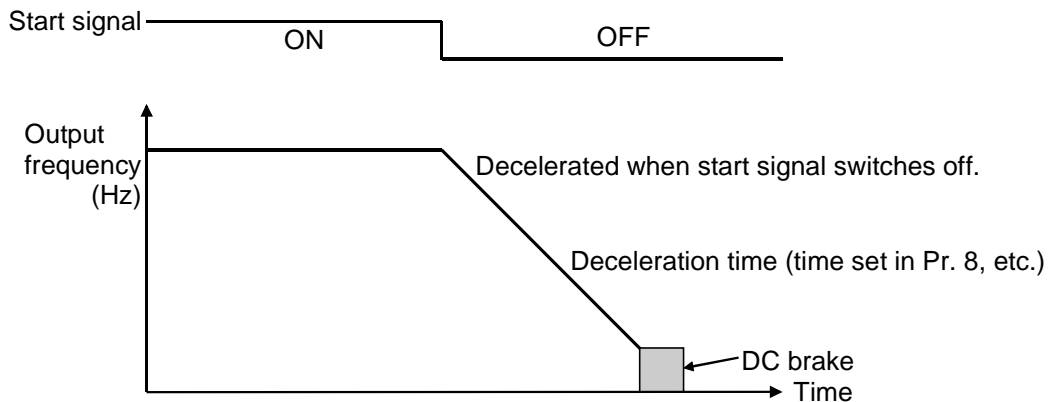
- Pr. 7 "acceleration time"
- Pr. 8 "deceleration time"
- Pr. 44 "second acceleration/ deceleration time"
- Pr. 45 "second deceleration time"

Used to select the stopping method (deceleration to a stop or coasting) when the DeviceNet control input command (STF/STR) switches off.

Parameter Number	Factory Setting	Setting Range
250	9999	0 to 100 s, 1000 to 1100 s, 8888, 9999

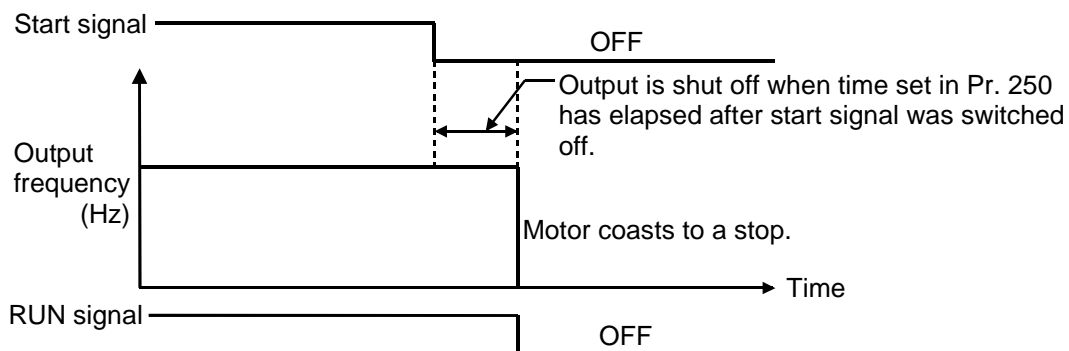
(1) Pr. 250 = "9999"

When the start signal switches off, the motor is decelerated to a stop.



(2) Pr. 250 = 0 to 100 seconds (output is shut off after preset time)

The output is shut off when the time set in Pr. 250 has elapsed after the start signal was switched off. The motor coasts to a stop.



When the Pr. 250 value is 8888, the functions of terminals STF and STR change as shown below:

STF = start signal, STR = rotation direction signal

STF	STR	Inverter Operating Status
OFF	OFF	Stop
OFF	ON	
ON	OFF	Forward rotation
ON	ON	Reverse rotation

When the Pr. 250 value is any of 1000 to 1100s, the functions of terminals STF and STR are the same as when the Pr. 250 value is 8888.

Also, for the stopping method used when the start signal switches off, the output is shut off (the motor coasts to a stop) after the period set in Pr. 250 (i.e. 1000s) have elapsed.

- Note: 1. The RUN signal switches off when the output stops.  
 2. When the start signal is switched on again during motor coasting, the motor starts at 0Hz.  
 3. When the Pr. 250 value is 0, the output is shut off within the shortest time.

**4.2.42 DeviceNet specific parameters (Pr. 345 to Pr. 348)**

**Pr. 345 "DeviceNet Address Startup Data (Lower byte)"**

**Pr. 346 "DeviceNet Baudrate Startup Data (Lower byte)"**

**Pr. 347 "DeviceNet Address Startup (Higher byte)"**

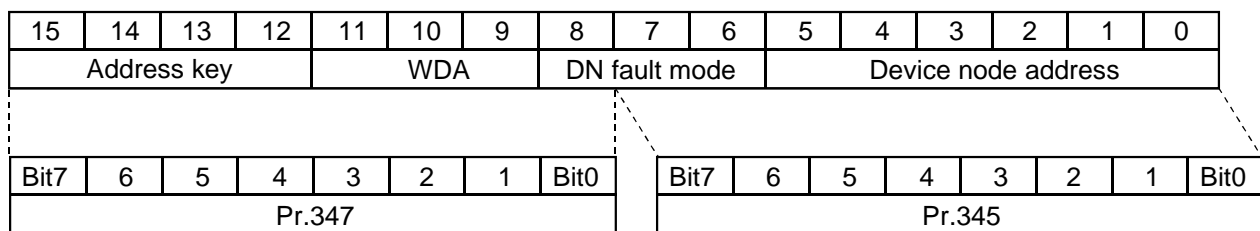
**Pr. 348 "DeviceNet Baudrate Startup Data (Higher byte)"**

Pr. 345 to Pr. 348 are specific DeviceNet parameters. They are described below.

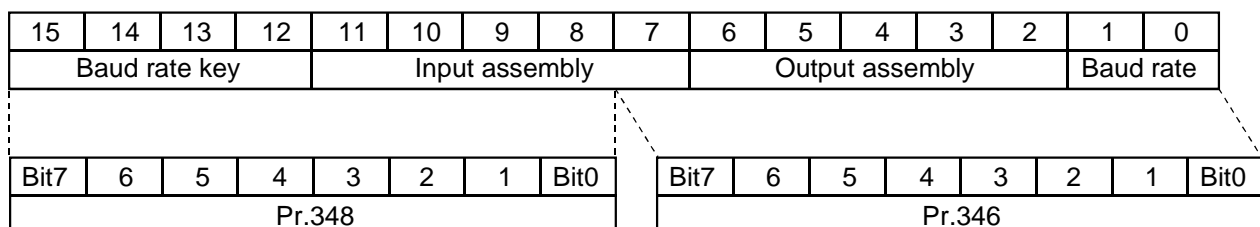
Pr. No.	Function	Setting Range	Minimum Increment	Default Setting
345	DeviceNet Address Startup Data (Lower byte)	0 to 255	1	63 (0x3F)
346	DeviceNet Baudrate Startup Data (Lower byte)	0 to 255	1	132 (0x84)
347	DeviceNet Address Startup Data (Higher byte)	0 to 255	1	160 (0xA0)
348	DeviceNet Baudrate Startup Data (Higher byte)	0 to 255	1	80 (0x50)

The PU displays only in decimal integers. The hexadecimal integers in the parentheses are used here for easy bitmap reference only.

Pr. 345 and Pr. 347 are bit-mapped parameters and are defined as follows.



Pr. 346 and Pr. 348 are bit-mapped parameters and are defined as follows.



Definitions of each registration

<b>Name</b>	<b>Description</b>	<b>Definition</b>	<b>Default setting</b>
Watch dog timeout operation (WDA) (Note)	DeviceNet connection object (Class code 0x05) Instance 2 attribute 12	0 = Transition to timeout 1 = Automatic delete 2 = Automatic reset	0
DN fault mode	Supports the control management object. (Class code 0x29) Instance attribute 16, DN fault mode	0 = Fault and stop 1 = Ignore	0
Input assembly	Value of assembly ID used in connection object. (Class code 0x05) Instance attribute 16, consumed_connection_path	Assembly ID 0 = 70 1 = 71 6 = 176 8 = 150	1
Output assembly	Assembly ID value used in connection object. (Class code 0x05) Instance attribute 14, produced_connection_path	Assembly instance ID 0 = 20 1 = 21 6 = 126 8 = 100	1
Baud rate	DeviceNet object value (Class code 0x03) Instance attribute 2, baud rate	0 = 125 kbps 1 = 250 kbps 2 = 500 kbps	0
Device address	DeviceNet object value (Class 0x03) Instance attribute 1, MAC ID	Node address; Range is 0 to 63 (same definition as attribute)	63
Address key	Internal confirmation	1010-setting value; No others	1010
Baud rate key	Internal confirmation	1010-setting value; No others	0101

Note: The parameter setting will be changed back to the factory setting (0) when reconnected after a disconnection.

Normally, these parameters are not accessed via the PU. Instead, a DeviceNet user will access the various fields of these parameters via DeviceNet and set them according to the table above.

**Pr. 990 to Pr. 991 → Refer to Pr. 145.**

# CHAPTER 5

## PROTECTIVE FUNCTIONS

This chapter explains the "protective functions" of this product.

Always read the instructions before using the equipment.

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Chapter 6

# 5.1 Errors (Alarms)

If any fault has occurred in the inverter, the corresponding protective function is activated to bring the inverter to an alarm stop and automatically give the corresponding error (alarm) indication on the PU display.

If your fault does not correspond to any of the following errors or if you have any other problem, please contact your sales representative.

- Retention of alarm output signal .... When the magnetic contactor (MC) provided on the power supply side of the inverter is opened at the activation of the protective function, the inverter's control power will be lost and the alarm output will not be held.
- Alarm indication ..... When the protective function is activated, the operation panel display automatically switches to the above indication.
- Resetting method ..... When the protective function is activated, the inverter output is kept stopped. Unless reset, therefore, the inverter cannot restart. Switch power off once, then on again; power off once, then on again; or apply RES signal for more than 0.1 seconds.
- When the protective function is activated, take the corresponding corrective action, then reset the inverter, and resume operation.

## 5.1.1 Operation at alarm occurrence

Fault	Operation Mode	
	DeviceNet™ operation	PU operation
Inverter fault	Continued	Continued
Communication error	Inverter trip	Stop

### (1) Inverter alarm

Refer to page page 135 and remove the cause of the alarm.

### (2) Communication alarm

Check the states of the operating status indicator LED and remove the cause of the alarm. Check the DeviceNet™ master station. (Refer to page 138)

If any fault has occurred in the inverter, the protective function is activated, the inverter comes to an alarm stop, and the ALARM lamp is lit. When the parameter unit (FR-PU04) is used, the PU display automatically gives any of the following error (alarm) indications.

When the protective function is activated, reset the inverter.

### 5.1.2 Error (alarm) definitions

#### **(1) Major faults**

When the protective function is activated, the inverter output is shut off and the alarm is output.

<b>FR-PU04 Indication</b>	OC During Acc
<b>Name</b>	Overcurrent shut-off during acceleration
<b>Description</b>	When the inverter output current reaches or exceeds approximately 200% of the rated current during acceleration, the protective circuit is activated to stop the inverter output.
<b>Check point</b>	Check for sudden acceleration. Check for output short-circuit/ground fault.
<b>Corrective action</b>	Increase the acceleration time.

<b>FR-PU04 Indication</b>	Stedy Spd OC
<b>Name</b>	Overcurrent shut-off during constant speed
<b>Description</b>	When the inverter output current reaches or exceeds approximately 200% of the rated current during constant speed, the protective circuit is activated to stop the inverter output.
<b>Check point</b>	Check for sudden load change. Check for output short-circuit/ground fault.
<b>Corrective action</b>	Keep load stable.

<b>FR-PU04 Indication</b>	OC During Dec
<b>Name</b>	Overcurrent shut-off during deceleration
<b>Description</b>	When the inverter output current reaches or exceeds approximately 200% of the rated current during deceleration (other than acceleration or constant speed), the protective circuit is activated to stop the inverter output.
<b>Check point</b>	Check for sudden speed reduction. Check for output short-circuit/ground fault. Check for too fast operation of motor's mechanical brake.
<b>Corrective action</b>	Increase the deceleration time. Adjust brake operation.

<b>FR-PU04 Indication</b>	OV During Acc
<b>Name</b>	Regenerative overvoltage shut-off during acceleration
<b>Description</b>	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. It may also be activated by a surge voltage generated in the power supply system.
<b>Check point</b>	Check for too slow acceleration.
<b>Corrective action</b>	Decrease the acceleration time.



## PROTECTIVE FUNCTIONS

<b>FR-PU04 Indication</b>	Stedy Spd OV
<b>Name</b>	Regenerative overvoltage shut-off during constant speed
<b>Description</b>	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. It may also be activated by a surge voltage generated in the power supply system.
<b>Check point</b>	Check for sudden load change.
<b>Corrective action</b>	<ul style="list-style-type: none"> <li>• Keep load stable.</li> <li>• Use the brake unit or high power factor converter (FR-HC) as required.</li> </ul>

<b>FR-PU04 Indication</b>	OV During Dec
<b>Name</b>	Regenerative overvoltage shut-off during deceleration or stop
<b>Description</b>	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. It may also be activated by a surge voltage generated in the power supply system.
<b>Check point</b>	Check for sudden speed reduction.
<b>Corrective action</b>	<ul style="list-style-type: none"> <li>• Increase the deceleration time. (Set the deceleration time which matches the inertia moment of the load)</li> <li>• Decrease the braking duty.</li> <li>• Use the brake unit or high power factor converter (FR-HC) as required.</li> </ul>

<b>FR-PU04 Indication</b>	Motor Overload
<b>Name</b>	Motor overload shut-off (electronic overcurrent protection) (Note 1)
<b>Description</b>	The electronic overcurrent protection in the inverter detects motor overheat due to overload or reduced cooling capability during constant-speed operation to stop the inverter output. When a multi-pole motor or two or more motors are run, provide a thermal relay in the output side of the inverter.
<b>Check point</b>	Check the motor for use under overload.
<b>Corrective action</b>	<ul style="list-style-type: none"> <li>• Reduce the load weight.</li> <li>• For the constant-torque motor, change the Pr. 71 setting to the constant-torque motor setting.</li> </ul>

<b>FR-PU04 Indication</b>	Inv. Overload
<b>Name</b>	Inverter overload shut-off (electronic overcurrent protection) (Note 1)
<b>Description</b>	If a current of more than 150% of the rated output current flows and overcurrent shut-off does not occur (200% or less), inverse-time characteristics cause the electronic overcurrent protection to be activated to stop the inverter output in order to protect the output transistors.
<b>Check point</b>	Check the motor for use under overload.
<b>Corrective action</b>	Reduce the load weight.

Note:1 Resetting the inverter initializes the internal heat integrating data of the electronic overcurrent protection.

## PROTECTIVE FUNCTIONS

<b>FR-PU04 Indication</b>	H/Sink O/Temp
<b>Name</b>	Fin overheat
<b>Description</b>	If the cooling fin overheats, the overheat sensor is actuated to stop the inverter output.
<b>Check point</b>	<ul style="list-style-type: none"> <li>• Check for too high ambient temperature.</li> <li>• Check for cooling fin clogging.</li> </ul>
<b>Corrective action</b>	Set the ambient temperature to within the specifications.

<b>FR-PU04 Indication</b>	Br. Cct. Fault (Note)
<b>Name</b>	Brake transistor alarm detection (Note 2)
<b>Description</b>	If a brake transistor fault occurs due to excessively large regenerative energy from the motor, for example, that fault is detected to stop the inverter output. <u>In this case, the inverter power must be switched off immediately.</u>
<b>Check point</b>	Check for improper braking duty.
<b>Corrective action</b>	Change the inverter. Please contact your sales representative.

Note:2 This function is activated only when the optional brake resistor is connected.

<b>FR-PU04 Indication</b>	Ground Fault
<b>Name</b>	Output side ground fault overcurrent protection
<b>Description</b>	This function stops the inverter output if a ground fault overcurrent flows due to a ground fault which occurred in the inverter's output (load) side. Use Pr. 249 "ground fault detection at start" to set whether the protective function is to be activated or not.
<b>Check point</b>	Check for a ground fault in the motor and connection cable.
<b>Corrective action</b>	Remedy the ground fault portion.

<b>FR-PU04 Indication</b>	OH Fault
<b>Name</b>	External thermal relay operation (Note 3)
<b>Description</b>	If the external thermal relay designed for motor overheat protection or the internally mounted temperature relay in the motor switches on (contacts open), the inverter output is stopped. If the relay contacts are reset automatically, the inverter will not restart unless it is reset.
<b>Check point</b>	<ul style="list-style-type: none"> <li>• Check for motor overheating.</li> <li>• Check that the value of 7 (OH signal) is set correctly in Pr. 183 "MRS terminal (MRS) function selection".</li> </ul>
<b>Corrective action</b>	Reduce the load and operating duty.

Note:3 This function is activated only when OH has been set for Pr. 183 "MRS terminal (MRS) function selection".

## PROTECTIVE FUNCTIONS

<b>FR-PU04 Indication</b>	Still Prev STP
<b>Name</b>	Stall prevention
<b>Description</b>	The running frequency has fallen to 0 by stall prevention activated. (OL while stall prevention is being activated.)
<b>Check point</b>	Check the motor for use under overload.
<b>Corrective action</b>	Reduce the load weight.

<b>FR-PU04 Indication</b>	Option Fault
<b>Name</b>	Option alarm
<b>Description</b>	Stops the inverter output if an internal connector fault occurs.
<b>Check point</b>	
<b>Corrective action</b>	Please contact your sales representative.

<b>FR-PU04 Indication</b>	Corrupt Memory
<b>Name</b>	Parameter storage device alarm
<b>Description</b>	A fault occurred in parameters stored (example: E <sup>2</sup> PROM fault).
<b>Check point</b>	Check for too many number of parameter write times.
<b>Corrective action</b>	Please contact your sales representative.

<b>FR-PU04 Indication</b>	PU Leave Out
<b>Name</b>	Parameter unit disconnection
<b>Description</b>	This function stops the inverter output if communication between the inverter and PU is suspended, e.g. the PU is disconnected, when "2", "3", "16" or "17" was set in Pr. 75. This function stops the inverter output if the number of successive communication errors is greater than the number of permissible retries when the Pr. 121 value is "9999" for RS-485 communication from the PU connector.
<b>Check point</b>	<ul style="list-style-type: none"> <li>• Check for loose fitting of the PU.</li> <li>• Check the Pr. 75 setting.</li> </ul>
<b>Corrective action</b>	Fit the PU securely.

<b>FR-PU04 Indication</b>	Retry No Over
<b>Name</b>	Retry count exceeded
<b>Description</b>	If operation cannot be resumed properly within the number of retries set, this function stops the inverter output.
<b>Check point</b>	Find the cause of alarm occurrence.
<b>Corrective action</b>	Eliminate the cause of the error preceding this error indication.

<b>FR-PU04 Indication</b>	CPU Fault
<b>Name</b>	CPU error
<b>Description</b>	If the arithmetic operation of the built-in CPU does not end within a predetermined period, the inverter self-determines it as an alarm and stops the output.
<b>Check point</b>	_____
<b>Corrective action</b>	Please contact your sales representative.

<b>FR-PU04 Indication</b>	E. LF
<b>Name</b>	Output phase failure protection
<b>Description</b>	This function stops the inverter output if one of the three phases (U, V, W) on the inverter's output side (load side) results in open phase.
<b>Check point</b>	<ul style="list-style-type: none"> <li>• Check the wiring (Check the motor for a fault.)</li> <li>• Check that the capacity of the used motor is not smaller than the inverter capacity.</li> </ul>
<b>Corrective action</b>	<ul style="list-style-type: none"> <li>• Wire the cables properly.</li> </ul>

**(2) Minor fault**

The output is not shut off when the protective function is activated. You can make parameter setting to output the minor fault signal. (Set "98" in Pr. 192 "A, B, C terminal (ABC) function selection". Refer to page 120.)



<b>FR-PU04 Indication</b>	Fan Failure
<b>Name</b>	Fan fault
<b>Description</b>	For the inverter which contains a cooling fan, this indication appears when the cooling fan stops due to a fault or operates differently from the setting of Pr. 244 "cooling fan operation selection".
<b>Check point</b>	Check the cooling fan for a fault.
<b>Corrective action</b>	Change the fan.

**(3) Warnings**

<b>FR-PU04 Indication</b>	OL	
<b>Name</b>	Stall prevention (overcurrent)	
<b>Description</b>	During acceleration	If a current of more than 150% (Note 4) of the rated inverter current flows in the motor, this function stops the increase in frequency until the overload current reduces to prevent the inverter from resulting in overcurrent shut-off. When the overload current has reduced below 150%, this function increases the frequency again.
	During constant-speed operation	If a current of more than 150% (Note 4) of the rated inverter current flows in the motor, this function lowers the frequency until the overload current reduces to prevent overcurrent shut-off. When the overload current has reduced below 150%, this function increases the frequency up to the set value.
	During deceleration	If a current of more than 150% (Note 4) of the rated inverter current flows in the motor, this function stops the decrease in frequency until the overload current reduces to prevent the inverter from resulting in overcurrent shut-off. When the overload current has reduced below 150%, this function decreases the frequency again.
<b>Check point</b>	Check the motor for use under overload.	
<b>Corrective action</b>	The acceleration/deceleration time may change. Increase the stall prevention operation level with Pr. 22 "stall prevention operation level", or disable stall prevention with Pr. 156 "stall prevention operation selection".	

Note: 4 The stall prevention operation current can be set as desired. It is factory-set to 150%.

<b>FR-PU04 Indication</b>	oL	
<b>Name</b>	Stall prevention (overvoltage)	
<b>Description</b>	During deceleration	If the regenerative energy of the motor increases too much to exceed the brake capability, this function stops the decrease in frequency to prevent overvoltage shut-off. As soon as the regenerative energy has reduced, deceleration resumes.
<b>Check point</b>	Check for sudden speed reduction.	
<b>Corrective action</b>	The deceleration time may change. Increase the deceleration time using Pr. 8 "deceleration time".	

<b>FR-PU04 Indication</b>	PS	
<b>Name</b>	PU stop	
<b>Description</b>	A stop made by pressing the  key of the PU has been set in Pr. 75 "PU stop selection".	
<b>Check point</b>	Check for a stop made by pressing the  key of the PU during DeviceNet operation.	
<b>Corrective action</b>	Refer to page 88.	

**5.1.3 To know the operating status at the occurrence of alarm**

If any fault has occurred in the inverter, the corresponding protective function is activated to bring the inverter to an alarm stop and automatically give the corresponding error (alarm) indication on the PU display.

If your fault does not correspond to any of the following errors or if you have any other problem, please contact your sales representative.


**5.1.4 Correspondence between digital and actual characters**

There are the following correspondences between the actual alphanumeric characters and the digital characters displayed on the control panel:

Actual	Display	Actual	Display	Actual	Display
0	0	A	A	M	M
1	1	B	B	N	N
2	2	C	C	O	O
3	3	D	D	o	o
4	4	E	E	P	P
5	5	F	F	S	S
6	6	G	G	T	T
7	7	H	H	U	U
8	8	I	I	V	V
9	9	J	J	r	r
		L	L	-	-

**5.1.5 Resetting the inverter**

The inverter can be reset by performing any of the following operations. Note that the electronic overcurrent protection's internal heat calculation value and the number of retries are cleared (erased) by resetting the inverter.

Operation 1: ..... Using the parameter unit (FR-PU04), press the  key to reset the inverter. (This may only be performed when the inverter protective function (major fault) is activated.)

Operation 2: ..... Switch power off once, then switch it on again.

Operation 3: ..... Switch on the reset signal (RES).

Operation 4: ..... Reset the inverter in Identity, Object, Reset, Services.  
(Refer to page 53)

Operation 5: ..... Switch on the RES-SD signal in the network program.

## 5.2 Troubleshooting

### PROTECTIVE FUNCTIONS

POINT: Check the corresponding areas. If the cause is still unknown, it is recommended to initialize the parameters (return to factory settings), re-set the required parameter values, and check again.

#### 5.2.1 Motor remains stopped

##### 1) Check the main circuit

- Check that a proper power supply voltage is applied (POWER lamp is lit).
- Check that the motor is connected properly.
- Check that the conductor across P1-P is connected.

##### 2) Check the input signals

- Check that the start signal is input.
- Check that both the forward and reverse rotation start signals are not input.
- Check that the frequency setting signal is not zero.
- Check that the output stop signal (MRS) or reset signal (RES) is not on.
- Check whether the terminals P24-SD are short-circuited.

##### 3) Check the parameter settings

- Check that the reverse rotation prevention (Pr. 78) is not selected.
- Check that the operation mode (Pr. 79) setting is correct.
- Check that the starting frequency (Pr. 13) setting is not greater than the running frequency.
- Check that various operational functions (such as three-speed operation), especially the maximum frequency (Pr. 1), are not zero.

##### 4) Check the load

- Check that the load is not too heavy.
- Check that the shaft is not locked.

##### 5) Others

- Check that the ALARM lamp is off.

#### 5.2.2 Motor rotates in opposite direction

- Check that the phase sequence of output terminals U, V and W is correct.
- Check that the start signals (forward rotation, reverse rotation) are connected properly.

**5.2.3 Speed greatly differs from the setting**

- Check that the frequency setting signal is correct. (Measure the input signal level.)
- Check that the following parameter settings are correct (Pr. 1, Pr. 2, Pr. 19, Pr. 245).
- Check that the input signal lines are not affected by external noise. (Use shielded cables)
- Check that the load is not too heavy.

**5.2.4 Acceleration/deceleration is not smooth**

- Check that the acceleration and deceleration time settings are not too short.
- Check that the load is not too heavy.
- Check that the torque boost setting is not too large to activate the stall prevention function.

**5.2.5 Motor current is large**

- Check that the load is not too heavy.
- Check that the torque boost setting is not too large.

**5.2.6 Speed does not increase**

- Check that the maximum frequency setting is correct.
- Check that the load is not too heavy. (In agitators, etc., load may become heavier in winter.)
- Check that the torque boost setting is not too large to activate the stall prevention function.
- Check that the brake resistor is not connected to terminals P-P1 accidentally.

**5.2.7 Speed varies during operation**

When slip compensation is selected, the output frequency varies with load fluctuation between 0 and 2Hz. This is a normal operation and is not a fault.

**1) Inspection of load**

- Check that the load is not varying.

**2) Inspection of input signal**

- Check that the frequency setting signal is not varying.
- Check that the frequency setting signal is not affected by noise.

**3) Others**

- Check that the setting of the applied motor capacity (Pr. 80) is correct for the inverter capacities in general-purpose magnetic flux vector control.
- Check that the wiring length is within 30m in general-purpose magnetic flux vector control.
- Check that the wiring length is correct in V/F control.



**5.2.8 The operation mode does not change to the DeviceNet operation mode**

- Check that the inverter and cable are correctly connected.  
(Is there any contact failure, disconnection, etc.?)
- Check that the node address setting switch is correctly set. (Does the setting match the program? Is the node address duplicated or outside the range?)
- Check that the operation mode changeover program has been executed.
- Check that the program mode changeover program is correctly designed.

**5.2.9 The inverter does not start even after entering the DeviceNet operation mode**

- Check that the operation mode is the DeviceNet operation mode.
- Check that the program for starting the inverter has been correctly designed.
- Check that the program for starting the inverter has been executed.
- Check whether outputs have been made from the inverter.

**5.2.10 Parameter write cannot be performed**

- Make sure that operation is not being performed.
- Make sure that you are not attempting to set the parameter outside the setting range.
- Make sure that you are not attempting to set the parameter in the external operation mode.
- Check Pr. 77 "parameter write inhibit selection".

**5.2.11 How to check for errors using the operation status indicator LED**

State of System	LED Condition	Notes
Inverter power off Network Power on	Off	Turn the inverter power on. The inverter unit will then complete duplicate node address test.
Power on the inverter when network Power is off.		Turn the network power on. The inverter unit will then complete duplicate node address test.
Network and inverter power on. Connection not yet established by master	Flashing Green	The inverter unit has powered up successfully and determined that its node address does not conflict with other stations. However, a master has not yet established a communication link.
Network and inverter power on. Connection established by master	Steady Green	A master device on the network has designated the inverter unit for communication. LED holds this state during communication also.
Connection Time-Out	Flashing Red	Master designated inverter unit for communication (LED Green state), but then sent no messages within the time limit set in the expected packet rate. Check to see that master station has not been disconnected from the network.
Critical Link failure	Steady Red	Failed communication device. <ul style="list-style-type: none"> <li>• Duplicate node address.</li> <li>• Network power off.</li> <li>• Cable from option unit to network not connected or severed.</li> <li>• Inverter unit is only node on network.</li> <li>• Network damaged.</li> <li>• Must cycle power to recover from this fault.</li> </ul>

If a fault occurs and the inverter fails to operate properly, locate the cause of the fault and take proper corrective action by referring to page 135. If the corresponding information is not found the inverter may have a problem, or the component parts maybe damaged, contact your local Mitsubishi sales representative.

### 5.2.12 Inspecting display on parameter unit and status LED

In response to the occurrence of a fault, the display unit of the inverter automatically displays the code of the detected fault and MNS Status LED shows the status of the detected fault.

Display		Possible Causes	Check	Corrective Action
FR-PU04 (Option)	LED			
E.OPT	Blinking Red	Connection time-out, Master designated inverter for communication, but sent no messages within time limit=4 × EPR.	Master station has not been disconnected from network.	Reset the inverter, Reconnect the network, Master is up and running, Master sends messages within time limit.
0.00	Steady Red	Duplicate node address; Network power off; Network cable offline; Inverter is only node, not even a Master is present; Network damaged.	No duplicate node address; Network power on; No damage to network; All cables are in proper connection; Master is on network.	Check required items in the left box, Reset the inverter, Restart the network.

## 5.3 Precautions for Maintenance and Inspection

### PROTECTIVE FUNCTIONS

The transistorized inverter is a static unit mainly consisting of semiconductor devices. Daily inspection must be performed to prevent any fault from occurring due to adverse influence by the operating environment, such as temperature, humidity, dust, dirt and vibration, changes in the parts with time, service life, and other factors.

#### 5.3.1 Precautions for maintenance and inspection

When the maintenance/inspection of the inverter is to be performed in the DeviceNet™ communication status, remove the terminal block for DeviceNet™ communication signals. Therefore, when more than 10 minutes have elapsed after power-off, make sure that the voltage across the main circuit terminals P - N (+ - -) of the inverter is 30VDC or less using a tester, etc. Then, access the inverter for inspection.

#### 5.3.2 Check items

##### (1) Daily inspection

- Check the following:
  - 1) Motor operation fault
  - 2) Improper installation environment
  - 3) Cooling system fault
  - 4) Unusual vibration and noise
  - 5) Unusual overheating and discoloration
- During operation, check the inverter input voltages using a meter.

##### (2) Cleaning

Always run the inverter in a clean state.

When cleaning the inverter, gently wipe dirty areas with a soft cloth immersed in neutral detergent or ethanol.

Note: Do not use solvent, such as acetone, benzene, toluene and alcohol, as they will cause the inverter surface paint to peel off.  
Do not use detergent or alcohol to clean the display and other sections of the parameter unit (FR-PU04) as these sections may deform.

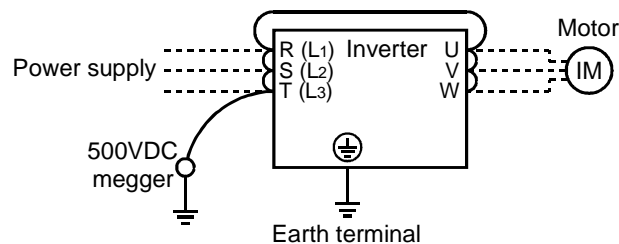
#### 5.3.3 Periodic inspection

Check the areas inaccessible during operation and requiring periodic inspection.

- 1) Cooling system: .....Clean the air filter, etc.
- 2) Screws and bolts: .....These parts may become loose due to vibration, temperature changes, etc. Check that they are tightened securely and retighten as necessary.
- 3) Conductors and insulating materials: Check for corrosion and damage.
- 4) Insulation resistance: Measure.
- 5) Cooling fan, smoothing capacitor: Check and change if necessary.

### 5.3.4 Insulation resistance test using megger

- 1) Before performing the insulation resistance test using a megger on the external circuit, disconnect the cables from all terminals of the inverter so that the test voltage is not applied to the inverter.
- 2) For the continuity test of the control circuit, use a meter (high resistance range) and do not use the megger or buzzer.
- 3) For the inverter, conduct the insulation resistance test on the main circuit only as shown below and do not perform the test on the control circuit. (Use a 500VDC megger.)



### 5.3.5 Pressure test

Do not conduct a pressure test. The inverter's main circuit uses semiconductors, which may deteriorate if a pressure test is made.

**5.3.6 Daily and periodic inspection**

Area of Inspection	Inspection Item	Description	Interval			Method	Criterion	Instrument
			Daily	Periodic*				
				1 year	2 years			
General	Surrounding environment	Check ambient temperature, humidity, dust, dirt, etc.	○			Refer to page 9.	Ambient temperature: -10°C to +50°C, non-freezing. Ambient humidity: 90% or less, non-condensing.	Thermometer, hygrometer, recorder
	Overall unit	Check for unusual vibration and noise.	○			Visual and auditory checks.	No fault.	
	Power supply voltage	Check that main circuit voltage is normal.	○			Measure voltage across inverter terminals R-S-T (L1-L2-L3).	Within permissible AC (DC) voltage fluctuation (Refer to page 149)	Meter, digital multimeter
Main circuit	General	(1) Check with megger (across main circuit terminals and ground terminal). (2) Check for loose screws and bolts. (3) Check for overheat on each part. (4) Clean.			○	(1) Disconnect all cables from inverter and measure across terminals R (L1), S (L2), T (L3), U, V, W and ground terminal with megger. (2) Retighten. (3) Visual check.	(1) 5MΩ or more.  (2), (3) No fault.	500VDC class megger
	Conductors, cables	(1) Check conductors for distortion. (2) Check cable sheaths for breakage.		○	○	(1), (2) Visual check.	(1), (2) No fault.	
	Terminal block	Check for damage.		○		Visual check	No fault	
	Inverter module Converter module	Check resistance across terminals.			○	Disconnect cables from inverter and measure across terminals R, S, T-P, N (L1, L2, L3 - +, -), and across U, V, W-P (+), N (-) with a meter with a 100Ω range.	Refer to page 144.	Analog meter
	Smoothing capacitor	(1) Check for liquid leakage. (2) Check for safety valve projection and bulge. (3) Measure electrostatic capacity.	○	○	○	(1), (2) Visual check.  (3) Measure with capacity meter.	(1), (2) No fault.  (3) 85% or more of rated capacity.	Capacity meter

## PROTECTIVE FUNCTIONS

Area of Inspection	Inspection Item	Description	Interval			Method	Criterion	Instrument
			Daily	Periodic*				
				1 year	2 years			
Control circuit Protective circuit	Operation check	(1) Check balance of output voltages across phases with inverter operated independently. (2) Perform sequence protective operation test to make sure there is no fault in protective or display circuits.	○	○	○	(1) Measure voltage across inverter output terminals U-V-W.  (2) Simulate connection of inverter protective circuit output terminals.	(1) Phase-to-phase voltage balance within 4V for 200V. (2) Fault must occur because of sequence.	Digital multimeter, rectifier type voltmeter
Cooling system	Cooling fan	(1) Check for unusual vibration and noise. (2) Check for loose connection.	○	○	○	(1) Turn by hand with power off. (2) Visual check.	No unusual vibration and unusual noise.	
Display	Display	(1) Check for LED lamp blown. (2) Clean.	○	○	○	(1) Lamps indicate indicator lamps on panel. (2) Clean with rag.	(1) Check that lamps are lit.	
	Meter	Check that reading is normal.	○	○	○	Check reading of meters on panel.	Must satisfy specified and management values.	Voltmeter, ammeter, etc.
Motor	General	(1) Check for unusual vibration and noise. (2) Check for unusual odor.	○	○	○	(1) Auditory, sensory, visual checks. (2) Check for unusual odor due to overheat, damage, etc.	(1), (2) No fault.	
	Insulation resistance	Check with megger (across terminals and ground terminal).	○	○	○	Disconnect cables from U, V, W, including motor cables.	5MΩ or more.	500V megger

\* For periodic inspection, contact you nearest Mitsubishi sales representative.

● **Checking the inverter and converter modules**

**<Preparation>**

- (1) Disconnect the external power supply cables (R, S, T (L1, L2, L3)) and motor cables (U, V, W).
- (2) Prepare a meter. (Use 100Ω range.)

**<Checking method>**

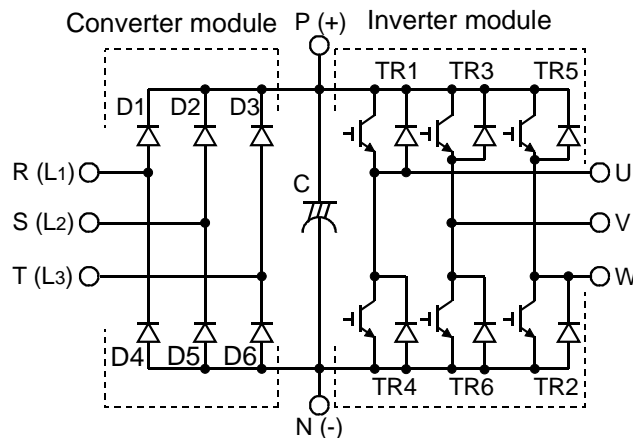
Change the polarity of the meter alternately at the inverter terminals R (L1), S (L2), T (L3), U, V, W, P (+) and N (-), and check for continuity.

Note: 1. Before measurement, check that the smoothing capacitor is discharged.  
 2. At the time of continuity, the measured value is several to several ten's-of ohms depending on the number of modules, number of parallel modules, circuit tester type, etc. If all measured values are almost the same, the modules are without fault.

**<Module device numbers and terminals to be checked>**

		Tester Polarity		Measured Value			Tester Polarity		Measured Value
		⊕	⊖				⊕	⊖	
Converter module	D1	R (L1)	P (+)	Discontinuity	D4	R (L1)	N (-)	Continuity	
		P (+)	R (L1)	Continuity		N (-)	R (L1)	Discontinuity	
	D2	S (L2)	P (+)	Discontinuity	D5	S (L2)	N (-)	Continuity	
		P (+)	S (L2)	Continuity		N (-)	S (L2)	Discontinuity	
	D3	T (L3)	P (+)	Discontinuity	D6	T (L3)	N (-)	Continuity	
		P (+)	T (L3)	Continuity		N (-)	T (L3)	Discontinuity	
Inverter module	TR1	U	P (+)	Discontinuity	TR4	U	N (-)	Continuity	
		P (+)	U	Continuity		N (-)	U	Discontinuity	
	TR3	V	P (+)	Discontinuity	TR6	V	N (-)	Continuity	
		P (+)	V	Continuity		N (-)	V	Discontinuity	
	TR5	W	P (+)	Discontinuity	TR2	W	N (-)	Continuity	
		P (+)	W	Continuity		N (-)	W	Discontinuity	

(Assumes the use of an analog meter.)





### 5.3.7 Replacement of parts

The inverter consists of many electronic parts such as semiconductor devices. The following parts may deteriorate with age because of their structural or physical characteristics, leading to reduced performance or failure of the inverter. For preventive maintenance, the parts must be changed periodically.

Part Name	Standard Replacement Interval	Description
Cooling fan	2 to 3 years	Change (as required)
Smoothing capacitor in main circuit	5 years	Change (as required)
Smoothing capacitor on control board	5 years	Change the board (as required).

Note: For part replacement, contact the nearest Mitsubishi FA center.

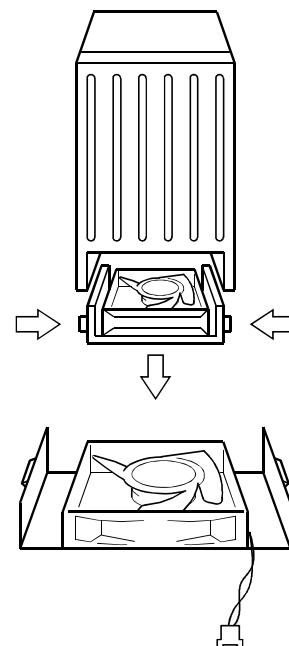
#### **(1) Cooling fan**

The cooling fan cools heat-generating parts such as the main circuit semiconductor devices. The life of the cooling fan bearing is usually 10,000 to 35,000 hours. Hence, the cooling fan must be changed every 2 to 3 years if the inverter is run continuously. When unusual noise and/or vibration is noticed during inspection, the cooling fan must be changed immediately. When you need to change the cooling fan, contact the nearest Mitsubishi FA Center.

Inverter Model No.	Fan Type
FR-E520-0.75KND	MMF-04C24DS BKO-CA1382H01
FR-E520-1.5KND, 2.2KND, 3.7KND FR-E520S-0.75KND	MMF-06D24DS BKO-C2416H07
FR-E520-5.5K, 7.5KND	MMF-06D24ES BKO-CA1027H08

#### ● Removal

- 1) Remove the wiring cover. (Refer to page 6.)
- 2) Unplug the fan connector.  
The cooling fan is plugged into the cooling fan connector beside the inverter terminal block.  
Unplug the connector and separate the inverter from the cooling fan.
- 3) Remove the cooling fan cover.  
Push the cover in the direction of arrow and pull it down.
- 4) Remove the cooling fan and cooling fan cover.  
The cooling fan is secured by the fixing catches.  
Disengage the fixing catches to remove the cooling fan and cooling fan cover.

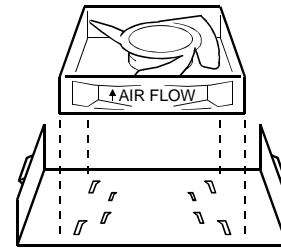
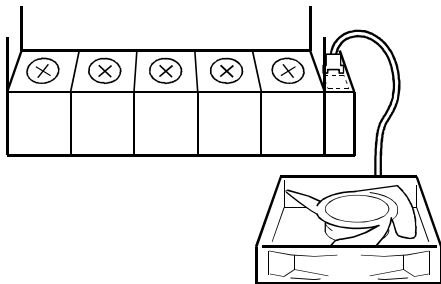


● **Reinstallation**

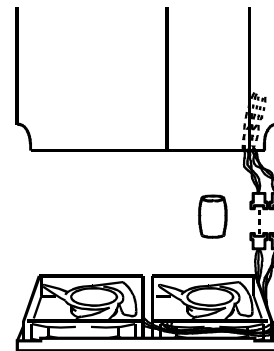
- 1) After confirming the orientation of the fan, reinstall the fan to the cover so that the arrow on the left of "AIR FLOW" faces in the opposite direction of the fan cover.

Note: If the air flow is set in the wrong direction, the inverter life can be shorter.

- 2) Reinstall the fan cover to the inverter.  
Run the cable through the wiring groove to prevent it from being caught between the chassis and cover.
- 3) Reconnect the cable to the connector.
- 4) Reinstall the wiring cover.



(For 5.5K, 7.5K)



\*Wire the cables using care so that they are not caught by the cooling fan.

**(2) Smoothing capacitors**

A large-capacity aluminum electrolytic capacitor is used for smoothing the DC in the main circuit, and an aluminum electrolytic capacitor is also used for stabilizing the control power in the control circuit.

Their characteristics are adversely affected by ripple current, etc. When the inverter is operated in an ordinary, air-conditioned environment, change the capacitors about every 5 years. When 5 years have elapsed, the capacitors will deteriorate more rapidly. Check the capacitors at least every year (less than six months if the life will be expired soon). Check the following:

- 1) Case (side faces and bottom face for expansion)
- 2) Sealing plate (for remarkable warp and extreme crack)
- 3) Appearance, external cracks, discoloration, leakage.

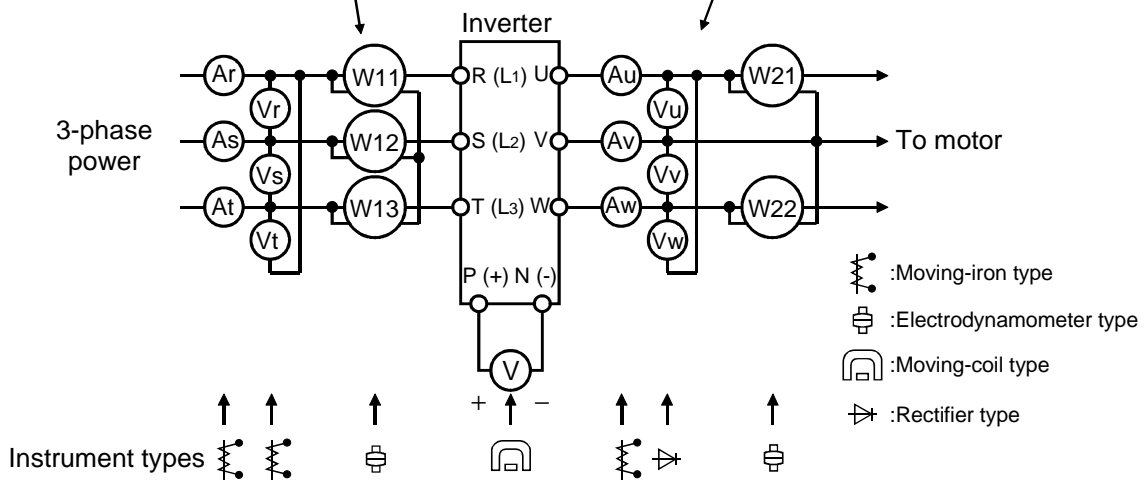
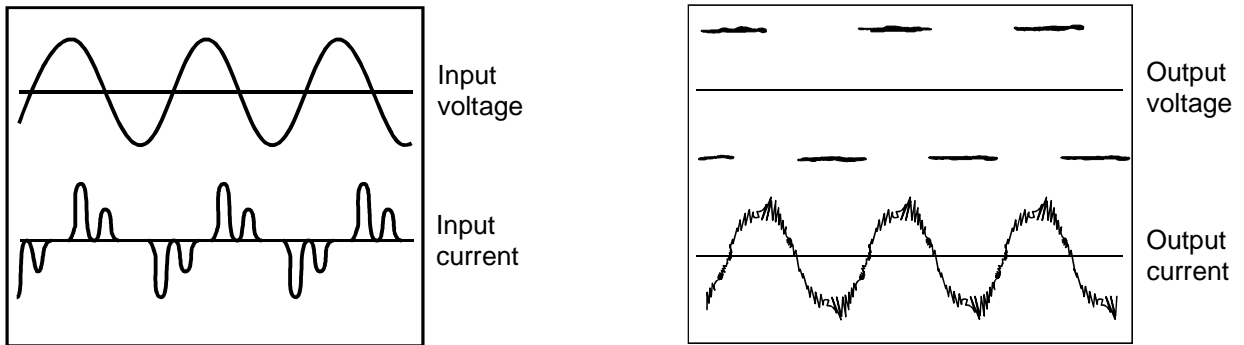
When the measured capacitance of the capacitor has reduced below 85% of the rating, change the capacitor.

### 5.3.8 Measurement of main circuit voltages, currents and powers

● **Measurement of voltages and currents**

Since the voltages and currents on the inverter power supply and output sides include harmonics, accurate measurement depends on the instruments used and circuits measured. When instruments for commercial frequency are used for measurement, measure the following circuits using the instruments given on the next page.

Three-phase 200V power input



**Typical Measuring Points and Instruments**

Note: Use FFT (Fast Fourier Transforms) to measure the output voltage accurately.  
It cannot be measured accurately with a meter or general instrument.

### Measuring Points and Instruments

Item	Measuring Point	Measuring Instrument	Remarks (Reference Measured Value)
Power supply voltage (V1)	Across R-S (L1-L2), S-T (L2-L3) and T-R (L3-L1)	Moving-iron type AC voltmeter	Is the commercial power supply within permissible variation of AC voltage (Refer to page 149)
Power supply side current (I1)	R, S and T line currents (L1, L2 and L3 line currents)	Moving-iron type AC ammeter	
Power supply side power (P1)	At R (L1), S (L2) and T (L3), and across R-S (L1-L2), S-T (L2-L3) and T-R (L3-L1)	Electrodynamic type single-phase wattmeter	P1 = W11 + W12 + W13 (3-wattmeter method)
Power supply side power factor (Pf1)	Calculate after measuring power supply voltage, power supply side current and power supply side power. $Pf1 = \frac{P1}{\sqrt{3}V1 \times I1} \times 100 \%$		
Output side voltage (V2)	Across U-V, V-W and W-U	(Note 1) (Cannot be measured by moving-iron type)	Difference between phases is within $\pm 1\%$ of maximum output voltage.
Output side current (I2)	U, V and W line currents	Moving-iron type AC ammeter (Note 2)	Current should be equal to or less than rated inverter current. Difference between phases is 10% or lower.
Output side power (P2)	At U, V and W, and across U-V and V-W	Electrodynamic type single-phase wattmeter	P2 = W21 + W22 2-wattmeter method (or 3-wattmeter method)
Output side power factor (Pf2)	Calculate in similar manner to power supply side power factor. $Pf2 = \frac{P2}{\sqrt{3}V2 \times I2} \times 100 \%$		
Converter output	Across P-N (+ - -)	Moving-coil type (such as tester)	Inverter LED display is lit. $1.35 \times V1$ Maximum 380V during regenerative operation
Reset	Across RES (positive)-SD	Moving-coil type (Meter, etc. may be used) (Internal resistance: 50k $\Omega$ or larger)	20 to 30VDC when open. ON voltage: 1V or less
Output stop	Across MRS (positive)-SD		
Alarm signal	Across A-C Across B-C	Moving-coil type (such as a meter)	Continuity check <Normal> <Fault> Across A-C: Discontinuity Continuity Across B-C: Continuity Discontinuity

Note: 1. Use FFT to measure the output voltage accurately. It can not be measured accurately with a meter or general instrumentation.  
 2. If the carrier frequency exceeds 5kHz, do not use this instrument since using it may increase eddy-current loss produced in metal parts inside the instrument, leading to burnout.  
 In this case, use an approximate effective value type instrument.

# CHAPTER 6

# SPECIFICATIONS

This chapter provides the "specifications" of this product.  
Always read the instructions before using the equipment

6.1 Standard Specifications ..... 149

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

# 6.1 Standard Specifications

## SPECIFICATIONS

### 6.1.1 Model specifications

#### ● 3-phase 200V power supply

Type FR-E520-□□ KND	0.1	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	
Applicable motor capacity (kW) (Note 1)	0.1	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	
Output	Rated capacity (kVA) (Note 2)	0.3	0.6	1.2	2.0	3.2	4.4	7.0	9.5	13.1
	Rated current (A) (Note 6)	0.8 (0.8)	1.5 (1.4)	3 (2.5)	5 (4.1)	8 (7)	11 (10)	17.5 (16.5)	24 (23)	33 (31)
	Overload capacity (Note 3)	150% 60s 200% 0.5s (inverse-time characteristics)								
	Voltage (Note 4)	Three phase, 200V to 240V 50Hz/60Hz								
Power supply	Rated input AC (DC) voltage, frequency	Three phase, 200V to 240V 50Hz/60Hz (280VDC, Note 7)								
	Permissible AC (DC) voltage fluctuation	170 to 264V 50Hz/60Hz (252 to 310VDC, Note 7)								
	Permissible frequency fluctuation	±5%								
	Power supply system capacity (kVA) (Note 5)	0.4	0.8	1.5	2.5	4.5	5.5	9	12	17
Protective structure (JEM1030)	Enclosed type (IP20)									
Cooling system	Self-cooling				Forced air cooling					
Approximate weight (kg)	0.6	0.6	0.8	1.0	1.7	1.7	2.2	4.4	4.9	

- Note: 1. The applicable motor capacity indicated is the maximum capacity applicable when a Mitsubishi 4-pole standard motor is used.
2. The rated output capacity indicated assumes that the output voltage is 230V.
3. The overload capacity indicated in % is the ratio of the overload current to the inverter's rated current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
4. The maximum output voltage cannot exceed the power supply voltage. The maximum output voltage may be set as desired below the power supply voltage. However, the crest value of the inverter output voltage remains unchanged from the DC bus voltage.
5. The power supply capacity changes with the values of the power supply side inverter impedances (including those of the input reactor and cables).
6. The rated output current in the parentheses applies when low acoustic noise operation is to be performed at the ambient temperature higher than 40°C with the Pr. 72 (PWM frequency selection) value set to 2kHz or higher.
7. When using a DC power supply
- (1) The guideline for the power supply voltage fluctuation range is 280VDC ±10%, and usually use the power supply at or below 300VDC.
  - (2) When DC power is switched on, a larger inrush current flows than in AC power. The number of power-on times should be minimized.
  - (3) 300VDC must be reserved to make the torque characteristic equal to when AC power supply is used.

**6.1.2 Common specifications**

Control specifications	Control system		Soft-PWM control/high carrier frequency PWM control can be selected. V/F control or general-purpose magnetic flux vector control can be selected.		
	Output frequency range		0.2 to 400Hz (starting frequency variable between 0 and 60Hz)		
	Frequency setting resolution	Digital input	0.01Hz (less than 100Hz), 0.1Hz (100Hz or more)		
	Frequency accuracy	Digital input	Within 0.01% of set output frequency.		
	Voltage/frequency characteristic		Base frequency set as required between 0 and 400Hz. Constant torque or variable torque pattern can be selected.		
	Starting torque		150% or more (at 1Hz), 200% or more (at 3Hz) when general-purpose magnetic flux vector control or slip compensation is selected		
	Torque boost		Manual torque boost, 0 to 30% may be set.		
	Acceleration/deceleration time setting		0.01, 0.1 to 3600 s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/deceleration mode can be selected.		
	Braking torque	Regenerative (Note 3)	0.1K, 0.2K ... 150%, 0.4K, 0.75K ... 100%, 1.5K ... 50%, 2.2K, 3.7K, 5.5K, 7.5K ... 20%		
		DC injection brake	Operation frequency (0 to 120Hz), operation time (0 to 10 s), operation voltage (0 to 30%) variable		
	Current stall prevention operation level		Operation current level can be set (0 to 200% variable), presence or absence can be selected.		
	Voltage stall prevention operation level		Operation level is fixed, presence or absence can be selected.		
	Fast-response current limit level		Operation level is fixed, presence or absence can be selected.		
	Input signals	Frequency setting signal	Digital input	Entered through DeviceNet™ communication or from the parameter unit.	
		Start signal		Forward rotation and reverse rotation.	Possible by DeviceNet or parameter unit
Alarm reset		Used to reset alarm output provided when protective function is activated.	Possible by DeviceNet, parameter unit or (Pr. 192)		
Multi-speed selection		Up to 15 speeds can be selected. (Each speed can be set between 0 and 400Hz, running speed can be changed during operation from the parameter unit (FR-PU04).)	Possible with DeviceNet or input terminal.		
Second function selection		Used to select second functions (acceleration time, deceleration time, torque boost, base frequency, electronic overcurrent protection).			
Output stop		Instantaneous shut-off of inverter output (frequency, voltage).			
External thermal relay input		Thermal relay contact input for use when the inverter is stopped by the external thermal relay.			
V/F-general-purpose magnetic flux switching		Used to switch between V/F control and general-purpose magnetic flux vector control from outside the inverter.			

Control specifications	Operation functions		Maximum/minimum frequency setting, frequency jump operation, external thermal relay input selection, automatic restart operation after instantaneous power failure, forward/reverse rotation prevention, slip compensation, operation mode selection, offline auto tuning function DeviceNet operation.
	Output signals	Operating status	1 contact output (230VAC 0.3A, 30VDC 0.3A) can be selected from inverter running, up to frequency, frequency detection, overload alarm, zero current detection, output current detection, operation ready, minor fault and alarm.
Display	Control panel display	Operating status	Output voltage, output current, set frequency, running.
		Alarm definition	Alarm definition is displayed when protective function is activated. 4 alarm definitions are stored.
	LED display		Power application (POWER), Alarm (ALARM), Operating status
Protective/alarm functions			Overcurrent shut-off (during acceleration, deceleration, constant speed), regenerative overvoltage shut-off, undervoltage (Note 1), instantaneous power failure (Note 1), overload shut-off (electronic overcurrent protection), brake transistor alarm, output short circuit, stall prevention, brake resistor overheat protection, fin overheat, fan failure (Note 4), parameter error, PU disconnection, starting-time ground fault overcurrent protection.
Environment	Ambient temperature		Constant torque : -10°C to +50°C (non-freezing)
	Ambient humidity		90%RH or less (non-condensing)
	Storage temperature (Note 2)		-20°C to +65°C
	Ambience		Indoors (no corrosive and flammable gases, oil mist, dust and dirt.)
	Altitude, vibration		Maximum 1000m above sea level for standard operation. After that derate by 3% for every extra 500m up to 2500m (91%). 5.9m/s <sup>2</sup> or less (conforming to JIS C 0040)

Note: 1. When undervoltage or instantaneous power failure has occurred, alarm display or alarm output is not provided but the inverter itself is protected. Overcurrent, regenerative overvoltage or other protection may be activated at power restoration according to the operating status (load size, etc.)

2. Temperature applicable for a short period in transit, etc.

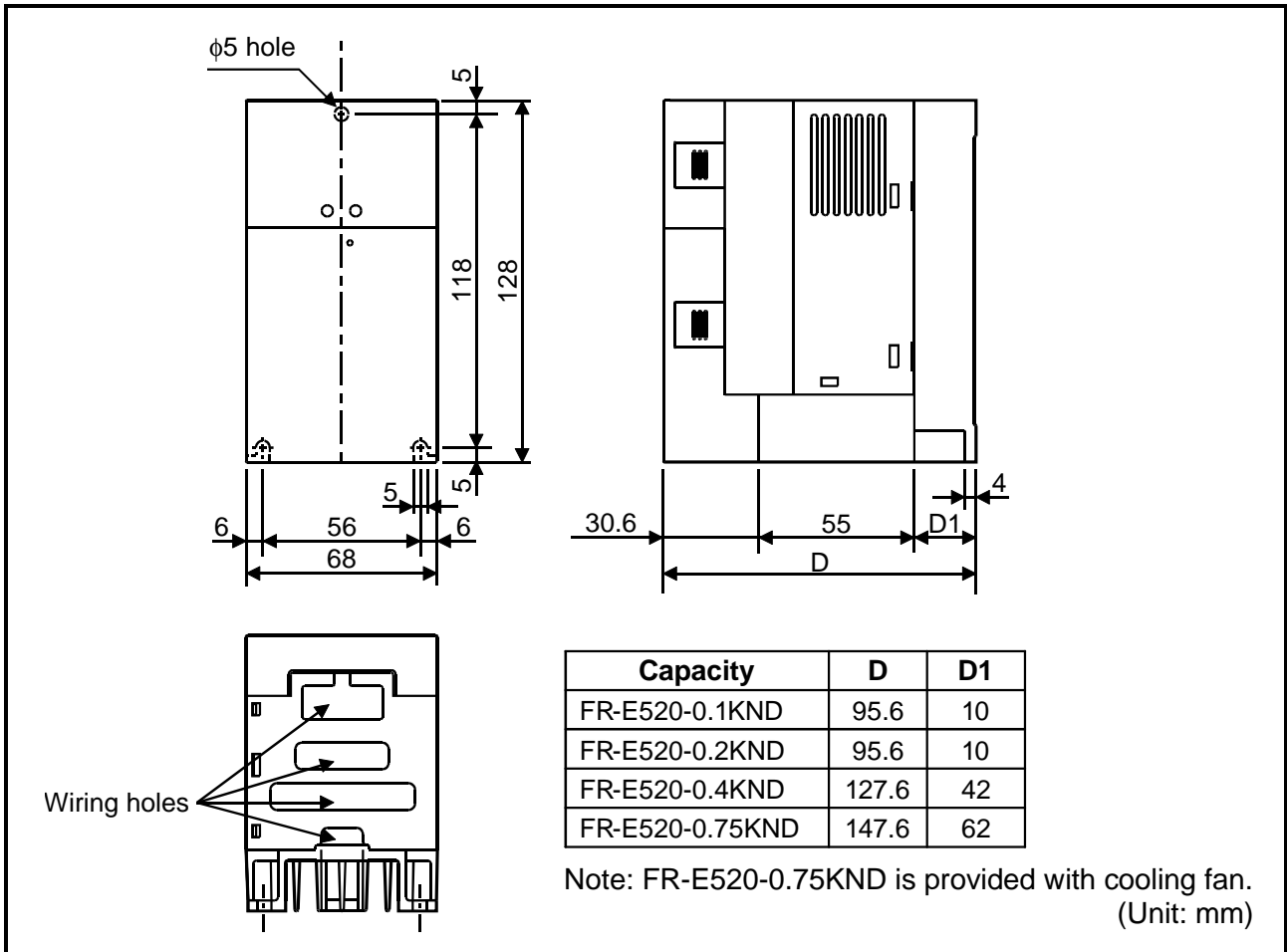
3. The braking torque indicated is a short-duration average torque (which varies with motor loss) when the motor alone is decelerated from 60Hz in the shortest time and is not a continuous regenerative torque. When the motor is decelerated from the frequency higher than the base frequency, the average deceleration torque will reduce. Since the inverter does not contain a brake resistor, use the optional brake resistor when regenerative energy is large. (The optional brake resistor cannot be used with 0.1K and 0.2K.) A brake unit (BU) may also be used.

4. Not provided for the FR-E520-0.1KND to 0.4KND which are not equipped with a cooling fan.

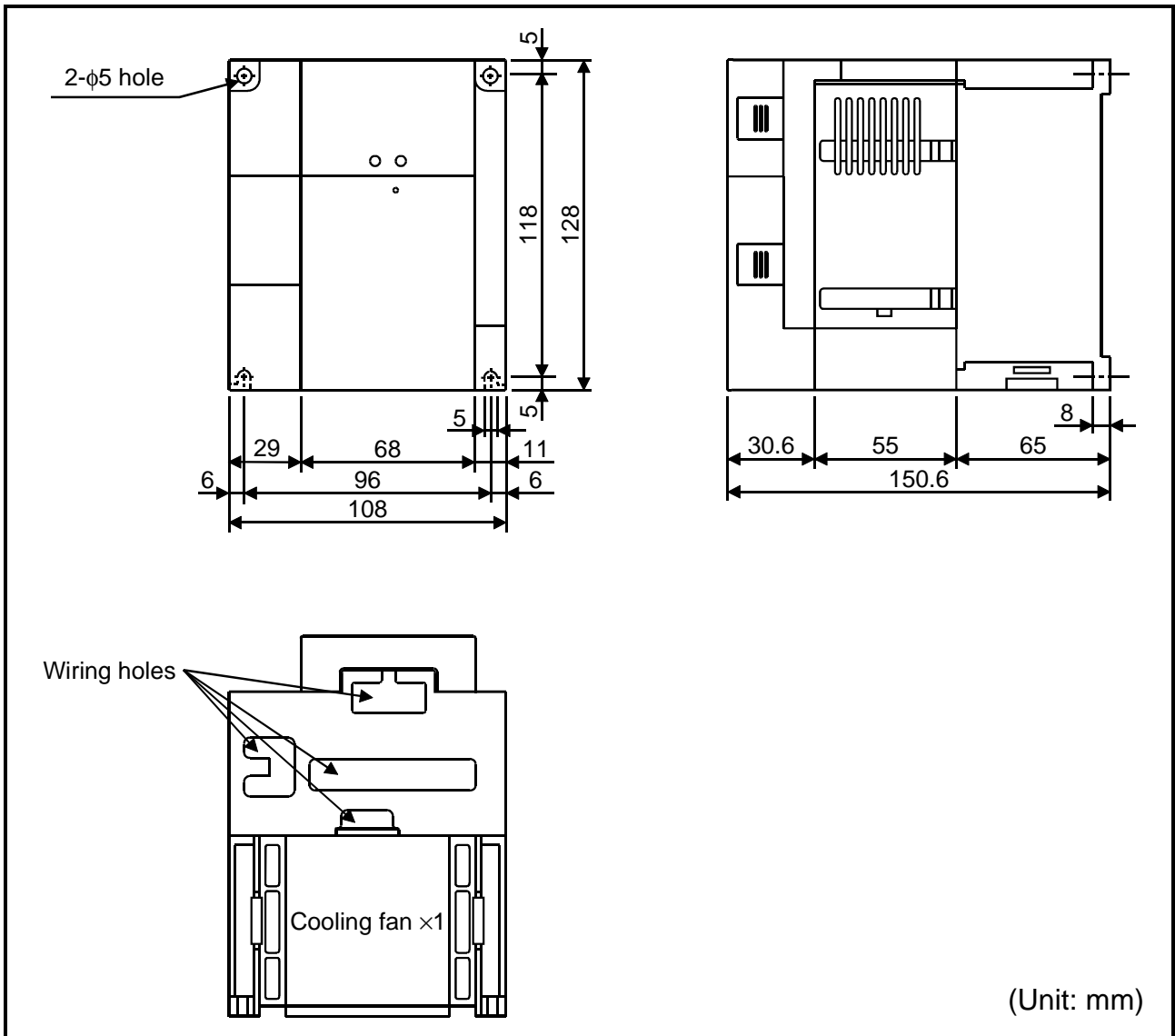


**6.1.3 Outline dimension drawings**

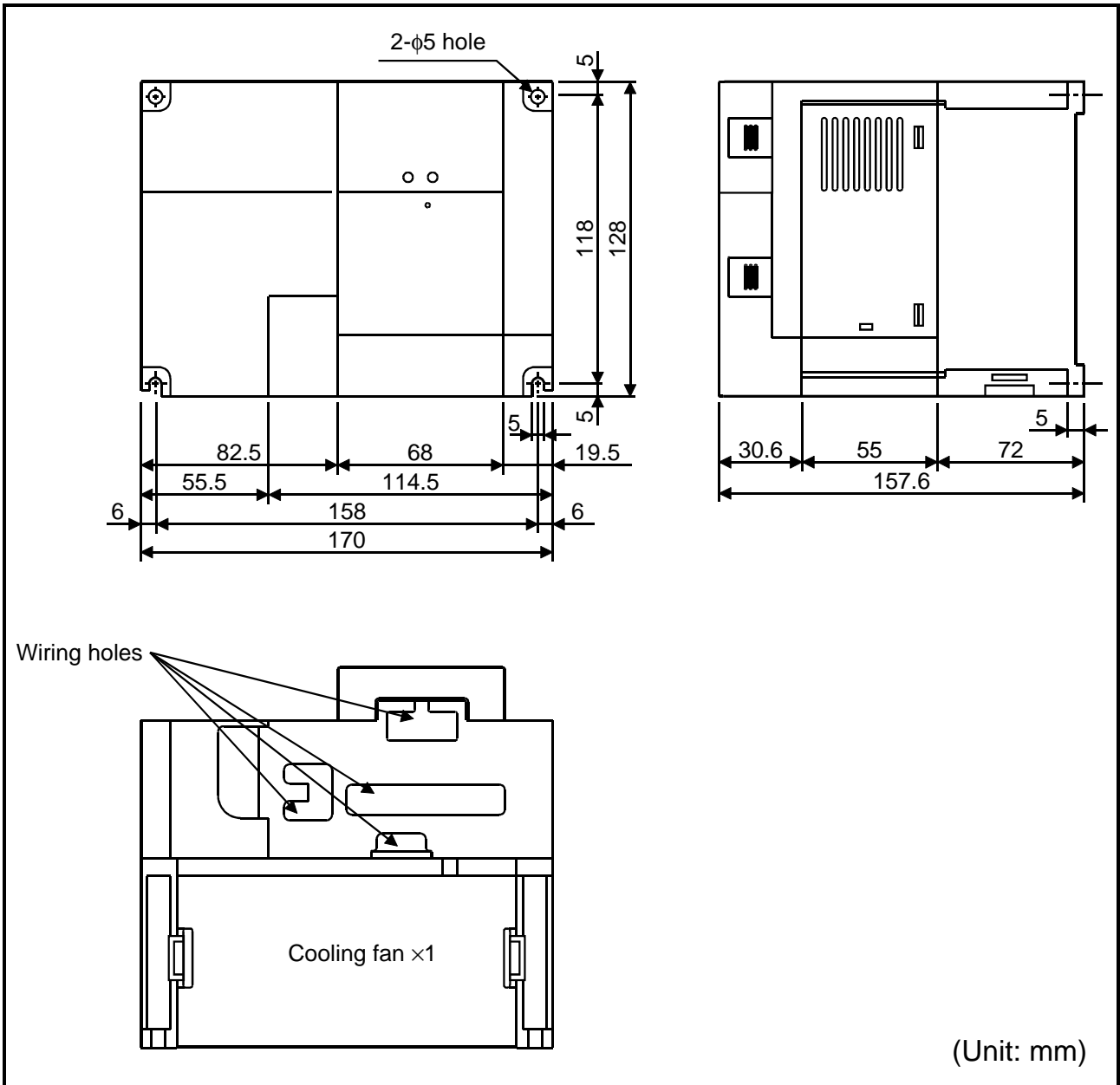
- FR-E520-0.1KND, 0.2KND, 0.4KND, 0.75KND



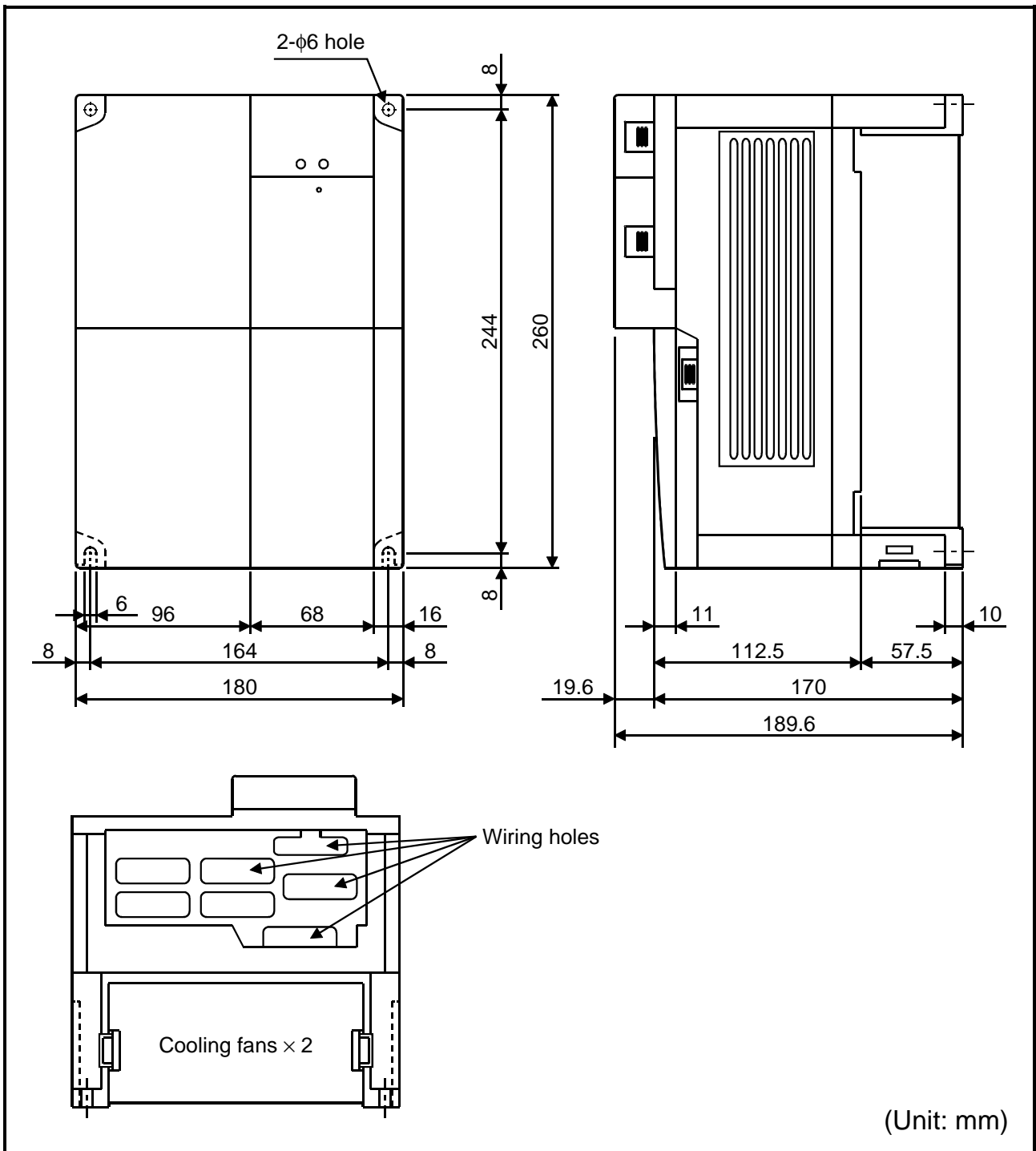
● **FR-E520-1.5KND, 2.2KND**



● **FR-E520-3.7KND**



● **FR-E520-5.5KND, 7.5KND**



### 6.1.4 DeviceNet specifications

---

- 1) Power supply
  - Communication power: supplied by DeviceNet power supply, 11 to 28 V with a 10 A capacity
- 2) Standard
  - Conforms to ODVA DeviceNet Specification, supports UCMM
- 3) Network topology
  - DeviceNet (linear bus with drop lines)
- 4) Transmission Media
  - DeviceNet standard thick or thin cable
- 5) Maximum cable distance
  - 500m at 125k baud with thick cable (see DeviceNet specification for details on maximum cable distance for different baud rates)
- 6) Transmission speed
  - 125kbps, 250kbps, 500kbps
- 7) Number of inverters connectable
  - 63 inverters with minimum of one node as a master

# APPENDIX

This chapter provides "supplementary information" for use of this product.

Always read the instructions before using the equipment.

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Appendix 4 Data Code List .....	185

# APPENDIX 1 Object Map

This section describes the DeviceNet object definitions of the FR-E500KND. For details of the definitions, please consult the DeviceNet documentation available from ODVA.

In the following tables, Get and Set mean:

Get: Read from inverter

Set: Write to inverter

## 1. Class 0x01 - Identity Object

### (1) Class 0x01 Attributes - Instance 0

No.	Access	Attribute	Type	Value
1	Get	Revision	Word	1
2	Get	Maximum Instance	Word	1
6	Get	Maximum Class Attributes	Word	7
7	Get	Maximum Instance Attributes	Word	7

### (2) Class 0x01 Services - Instance 0

Service Code	Service
0x0E	Get Attribute Single

### (3) Class 0x01 Instance Attributes - Instance 1

No.	Access	Attribute	Type	Value
1	Get	Vendor ID	Word	82 (0x0052)
2	Get	Product Type	Word	0x0002
3	Get	Product Code	Word	501 (0x1F5)
4	Get	Revision	Word	1.YYY (Note 1)
5	Get	Status	Word	0x0000
6	Get	Serial Number	Word	xxxxxxxx (Note 2)
7	Get	Name	Word	E500 (Note 3)

Note 1. The upper byte of the read hexadecimal word data indicates the integer part (major revision) and its lower byte indicates the fraction part (minor revision). For example, the read data of 0x010A means version 1.010.

2. The value changes with the product.

3. The actual data stored are 0x04, 0x45, 0x35, 0x30 and 0x30. The first 0x04 indicates the 4-byte data and the others indicate "E500" in ASCII

### (4) Class 0x01 Instance Services - Instance 1

Service Code	Service	Description
0x05	Reset	0-Power Reset 1-Parameter All Clear and Power Reset
0x0E	Get Attribute Single	

## 2. Class 0x03 - DeviceNet Object

### (1) Class 0x03 Attributes - Instance 0

Note: Not applicable to the FR-E500KND.

### (2) Class 0x03 Services - Instance 0

Note: Not applicable to the FR-E500KND.

### (3) Class 0x03 Instance Attributes - Instance 1

No.	Access	Attribute	Value
1	Get/Set	Node Address Setting (Note)	0 to 63
2	Get/Set	Baud Rate Setting (Note) (0: 125kbps, 1: 250kbps, 2: 500kbps)	0 to 2
3	Get/Set	Bus Off Interrupt 0: Hold CAN chip in reset state on detection of Bus Off. 1: Reset CAN chip and continues communication on detection of Bus Off.	0 to 1
4	Get/Set	Bus Off Counter (the number of times when the CAN chip resulted in bus off is counted)	0 to 255
5	Get	Allocation Information	0 to 0xFFFF
8	Get	MAC ID Switch Value	0 to 63
9	Get	Actual Value of Baud Rate	0 to 2

Note: Class 0x67 Instance 1 Attributes 45 and 46 may also be used to perform read.

### (4) Class 0x03 Instance Services - Instance 1

Service Code	Service
0x4B	Allocate
0x4C	Release
0x0E	Get Attribute Single
0x10	Set Attribute Single



### 3. Class 0x04 - Assembly Object

#### (1) Class 0x04 - Output Instance 20

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x14 20	0	–	–	–	–	–	Fault Reset	–	Run Fwd
	1	–							
	2	Speed Reference (Low Byte)							
	3	Speed Reference (High Byte)							

#### (2) Class 0x04 - Output Instance 21 (Default)

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x15 21	0	–	NetRef	NetCtrl	–	–	Fault Reset	Run Rev	Run Fwd
	1	–							
	2	Speed Reference (Low Byte)							
	3	Speed Reference (High Byte)							

#### (3) Class 0x04 - Output Instance 126

Instance	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0x7E 126	0	Write Param	NetRef	NetCtrl	–	–	Fault Reset	Run Rev	Run Fwd
	1	00							
	2	(Low Byte) Speed Ref or Parameter Write Data							
	3	(High Byte) Speed Ref or Parameter Write Data							
	4	Parameter Class							
	5	Parameter Attribute No.							

- Note 1. Before directing the inverter via the network, always turn on the bits of "NetCtrl" and "NetRef". If they are off, the inverter will not accept the directives even in the network operation mode.
2. When issuing a command, always hold the forward/reverse rotation flag in the present running status. Transmitting a wrong status will change the running status.  
(Example: The inverter will stop the output if bit 0 is turned off during the inverter forward rotation command.)
3. Always set "0" in Byte 1 of output instance 126. The inverter will not recognize any other value as normal data.

Output Instance 126 (0x7E) provides write/read parameter access control of the parameter class, the parameter attribute No., and the parameter data for a write operation.

Output Instance 126 **must** be used together with Input Instance 176 in those applications requiring parameter access.

Output Instance 126 utilizes 6 data bytes.

The Output Instance 126 bytes operate in the following manner:

**Byte 0:**

- Bit 7** - If Write Parameter=1, the Parameter Write Data is written to the parameter and the rest of the parameter is ignored.
- Bit 7** - If Write Parameter=0, the Speed Ref in RPM is set, and the rest of the command byte is executed.
- Bit 6** - If NetRef=1, the Speed Ref is taken from **Byte 2** and **Byte 3**. If 0, Speed Ref is not incorporated.
- Bit 5** - If NetControl = 0, the forward run, reverse run and error reset are valid. If 1, these are not validated.
- Bit 4** - Not Used.
- Bit 3** - Not Used.
- Bit 2** - If Fault Reset makes a transition from 0 to 1 and there is an error in the inverter, the inverter will reset.
- Bit 1** - If Run Rev=1 and Run Fwd=0, the drives rotates in the reverse direction.
- Bit 0** - If Run Fwd=1 and Run Rev=0, the drives spins in the forward direction.

Note: Net Control must=1 for Bits 2, 1, 0 to have any affect.

**Byte 1:** Must be 00.

**Byte 2:** Low Byte of the Speed Ref or Data Value.

**Byte 3:** High Byte of the Speed Ref or Data Value.

**Byte 4:** Parameter Class, e.g. 0x2A, 0x66, 0x67.

**Byte 5:** Parameter Attribute Number, e.g. 0x0A, 0x65.

**(4) Class 0x04 - Input Instance 70**

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x46 70	0	-	-	-	-	-	Run (1) Fwd	-	Faulted
	1	-							
	2	Speed Actual (Low Byte)							
	3	Speed Actual (High Byte)							

**(5) Class 0x04 - Input Instance 71 (Default)**

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x47 71	0	At Ref Speed	Ref From Net	Ctrl From Net	Ready	Run (2) Rev	Run (1) Fwd	-	Faulted
	1	-							
	2	Speed Actual (Low Byte)							
	3	Speed Actual (High Byte)							

**(6) Class 0x04 - Input Instance 176**

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0xB0 176	0	At Ref Speed	Ref From Net	Control From Net	Ready	Run (2) Rev	Run (1) Fwd	–	Faulted
	1	00							
	2	Speed Actual (Low Byte)							
	3	Speed Actual (High Byte)							
	4	Parameter Read (Low Byte)							
	5	Parameter Read (High Byte)							

The Input Instance 176 (0xB0) provide 16 bits of parameter data.

Input Instance 176 **must** be used together with Output Instance 126 in those applications requiring parameter access.

Input Instance 176 utilizes 6 data bytes.

The Input Instance 176 bytes operates in the following manner:

**Byte 0:**

**Bit 7** - At Ref Speed - 1: The drive is very close to or at the Ref Speed.

**Bit 6** - Ref From Net - 1: Speed setting comes from the DeviceNet master.

**Bit 5** - Control From Net - 1: Fault Reset, Run Rev, Run Fwd come from the DeviceNet Master.

**Bit 4** - Ready.

**Bit 3** - Run Rev - 1: Drive is rotating in the reverse direction.

**Bit 2** - Run Fwd - 1: Drive is rotating in the forward direction.

**Bit 1** - Not Supported.

**Bit 0** - 1: The drive is in a fault state.

**Byte 1:** Must be 00.

**Byte 2:** Low Byte of the Speed Actual.

**Byte 3:** High Byte of the Speed Actual.

**Byte 4:** Low Byte of Parameter.

**Byte 5:** High Byte of Parameter.

**(7) Class 0x04 - Input Instance 150**

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x96 150	0	–	–	OL	FU	–	Faulted	Running Rev	Running Fwd
	1	0x00							
	2	Actual Speed (Low Byte)							
	3	Actual Speed (High Byte)							
	4	Output Current (Low Byte)							
	5	Output Current (High Byte)							
	6	Error Factor							
	7	0x00							

Data Name	Contents
OL	1 is set during stall prevention operation.
FU	1 is set when output frequency reaches or exceeds the setting.
Faulted	1 is set when an inverter trip occurs.
Running Rev	If Running Rev = 1, running in reverse direction.
Running Fwd	If Running = 1, running in forward direction.
Actual Speed	Byte 2: Low-order byte of actual speed. Byte 3: High-order byte of actual speed.
Output Current	Byte 4: Low-order byte of output current. Byte 5: High-order byte of output current.
Error Factor	Error factor code when inverter alarm occurs.

Note: Output instance (100)

If any of the requests to the inverter of MRS, Fault Reset, Run Rev, Run Fwd, speed setting, acceleration time or deceleration time fail, this instance response will be an error response.

Limitation (MRS)

The MRS terminal can be assigned with Pr. 183.

When using the MRS terminal Pr. 183 must be assigned to “6”.

**(8) Class 0x04 - Output Instance 100**

Output Instance 0x64 100	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	0	Write Param	Net Ref	Net Ctrl	–	MRS	Fault Reset	Run Rev	Run Fwd
	1	0x00							
	2	Speed Reference (Low Byte)							
	3	Speed Reference (High Byte)							
	4	Acceleration Time (Low Byte)							
	5	Acceleration Time (High Byte)							
	6	Deceleration Time (Low Byte)							
	7	Deceleration Time (High Byte)							

Data Name	Contents
Write Param	1: The acceleration/deceleration time value is the value set with Byte 4, Byte 5, Byte 6 and Byte 7. (As this is written while running, writing is enabled only when Pr. 77 is 2.) 0: The acceleration/deceleration time value is not written.
Net Ref	1: The speed reference is the value set with Byte 2 and Byte 3. 0: The speed reference is the value set from the parameter unit.
Net Ctrl	1: MRS, Fault Reset, Run Rev and Run Fwd are operated with communications. 0: MRS, Fault Reset, Run Rev and Run Fwd are operated with the inverter.
Fault Reset	If Fault Reset makes a transition from 0 to 1 and there is an error in the inverter, the inverter will reset.
MRS	1: The inverter output is shut off. 0: The inverter output shut off is canceled.
Run Rev	If Run Rev is 1 and Run Fwd is 0, runs in reverse direction.
Run Fwd	If Run Fwd is 1 and Run Rev is 0, runs in forward direction.
Speed Reference	Byte 2: Low-order byte of speed reference. Byte 3: High-order byte of speed reference.
Acceleration Time	Byte 4: Low-order byte of acceleration time. Byte 5: High-order byte of acceleration time. (Acceleration time = Pr. 7)
Deceleration Time	Byte 6: Low-order byte of deceleration time. Byte 7: High-order byte of deceleration time. (Deceleration time = Pr. 8)

#### 4. Class 0x05 - DeviceNet Connection Object

The FR-E500KND supports only Polled I/O and Explicit Messaging. It does not support Bit-Strobed I/O.

##### (1) Class 0x05 Attributes - Instance 0

Note: Not applicable to the FR-E500KND.

##### (2) Class 0x05 Services - Instance 0

Note: Not applicable to the FR-E500KND.

##### (3) Class 0x05 Instance Attributes Instance 1 - Explicit Messaging

No.	Access	Attribute	Value
1	Get	State 0 - Non-existent 1 - Configuring 2 - Waiting for connection ID 3 - Established 4 - Timed out 5 - Deferred delete	0 to 5
2	Get	Instance Type 0 - Explicit Messaging connection 1 - Polled I/O connection	0 to 1
3	Get	Transport Trigger Class 0x83: Server Transport Class 3	0x83
4	Get	Produced Connection ID	0 to 0x7F0
5	Get	Consumed Connection ID	0 to 0x7F0
6	Get	Initial Comm Characteristics (Define the send and receive message groups.)	0x21
7	Get	Produced Connection Size (Max. number of bytes of sendable message body)	7
8	Get	Consumed Connection Size (Max. number of bytes of receivable message body)	7
9	Get/Set	Expected Packet Rate (EPR)	Default 2504
12	Get	Watchdog Action 0 - Transition to time out 1 - Auto delete 2 - Auto reset 3 - Deferred delete	0 to 3
13	Get	Produced Connection Path Length	0
14	Get	Produced Connection Path	(Variable)
15	Get	Consumed Connection Path Length	0
16	Get	Consumed Connection Path	(Variable)

Note: Refer to Vol. I: 5-4 of DeviceNet Specifications for details.

**(4) Class 0x05 Instance Attributes Instance 2 - Polled I/O**

No.	Access	Attribute	Value
1	Get	State	0 to 5
2	Get	Instance Type	0 to 1
3	Get	Transport Trigger Class	0x83
4	Get	Produced Connection ID	0 to 0x7F0
5	Get	Consumed Connection ID	0 to 0x7F0
6	Get	Initial Comm Characteristics	0x01
7	Get	Produced Connection Size	4
8	Get	Consumed Connection Size	4
9	Get/Set	Expected Packet Rate (EPR)	Default 0
12	Get/Set	Watchdog Action	0 to 3
13	Get/Set	Produced Connection Path Length	0
14	Get/Set	Produced Connection Path	(Variable)
15	Get/Set	Consumed Connection Path Length	0
16	Get/Set	Consumed Connection Path	(Variable)

Note: 1. Depends on the communication data used. 4 for use of output instances 20, 21 and input instances 70, 71 or 6 for use of output instance 126 and input instance 176.

2. Refer to Vol. I: 5-4 of DeviceNet Specifications for details.

**(5) Class 0x05 Instance Attributes Instance 3 - Explicit messaging**

No.	Access	Attribute	Value
1	Get	State	0 to 5
2	Get	Instance Type	0 to 1
3	Get	Transport Trigger Class	0x83
4	Get	Produced Connection ID	0 to 0x7F0
5	Get	Consumed Connection ID	0 to 0x7F0
6	Get	Initial Comm. Characteristics	0x33
7	Get	Produced Connection Size	7
8	Get	Consumed Connection Size	7
9	Get	Expected Packet Rate (EPR)	Default 2504
12	Get	Watchdog Action	0 to 3
13	Get	Produced Connection Path Length	0
14	Get/Set	Produced Connection Path	(Variable)
15	Get	Consumed Connection Path Length	0
16	Get/Set	Consumed Connection Path	(Variable)

Refer to Vol.I: 5-4 of DeviceNet Specifications for details.

**(6) Class 0x05 Instance Attributes Instance 4 - Explicit Messaging**

No.	Access	Attribute	Value
1	Get	State	0 to 5
2	Get	Instance Type	0 to 1
3	Get	Transport Trigger Class	0x83
4	Get	Produced Connection ID	0 to 0x7F0
5	Get	Consumed Connection ID	0 to 0x7F0
6	Get	Initial Comm. Characteristics	0x33
7	Get	Produced Connection Size	7
8	Get	Consumed Connection Size	7
9	Get/Set	Expected Packet Rate (EPR)	Default 2504
12	Get	Watchdog Action	0 to 3
13	Get	Produced Connection Path Length	0
14	Get	Produced Connection Path	(Variable)
15	Get	Consumed Connection Path Length	0
16	Get	Consumed Connection Path	(Variable)

Note: Refer to Vol.I: 5-4 of DeviceNet Specifications for details.

**(7) Class 0x05 Instance Attributes Instance 5 - Explicit Messaging**

No.	Access	Attribute	Value
1	Get	State	0 to 5
2	Get	Instance Type	0 to 1
3	Get	Transport Trigger Class	0x83
4	Get	Produced Connection ID	0 to 0x7F0
5	Get	Consumed Connection ID	0 to 0x7F0
6	Get	Initial Comm Characteristics	0x33
7	Get	Produced Connection Size	7
8	Get	Consumed Connection Size	7
9	Get/Set	Expected Packet Rate (EPR)	Default 2504
12	Get	Watchdog Action	0 to 3
13	Get	Produced Connection Path Length	0
14	Get	Produced Connection Path	(Variable)
15	Get	Consumed Connection Path Length	0
16	Get	Consumed Connection Path	(Variable)

Note: Refer to Vol.I: 5-4 of DeviceNet Specifications for details.



**(8) Class 0x05 Instance Attributes Instance 6 - Explicit Messaging**

No.	Access	Attribute	Value
1	Get	State	0 to 5
2	Get	Instance Type	0 to 1
3	Get	Transport Trigger Class	0x83
4	Get	Produced Connection ID	0 to 0x7F0
5	Get	Consumed Connection ID	0 to 0x7F0
6	Get	Initial Comm Characteristics	0x33
7	Get	Produced Connection Size	7
8	Get	Consumed Connection Size	7
9	Get/Set	Expected Packet Rate (EPR)	Default 2504
12	Get	Watchdog Action	0 to 3
13	Get	Produced Connection Path Length	0
14	Get	Produced Connection Path	(Variable)
15	Get	Consumed Connection Path Length	0
16	Get	Consumed Connection Path	(Variable)

Note: Refer to Vol.I: 5-4 of DeviceNet Specifications for details.

**(9) Class 0x05 Instance Services - Instances 1, 2, 3, 4, 5, 6**

Service Code	Service
0x0E	Get Attribute Single
0x10	Set Attribute Single

## 5. Class 0x28 - Motor Data Object

### (1) Class 0x28 Attributes - Instance 0

Note: Not applicable to the FR-E500KND.

### (2) Class 0x28 Services - Instance 0

Note: Not applicable to the FR-E500KND.

### (3) Class 0x28 Instance Attributes Instance 1

No.	Access	Attribute	Value
3	Get/Set	Motor Type	7 (Induction Motor)
6	Get/Set	Rated Current,	Setting Value for Pr. 9
7	Get/Set	Rated Voltage,	Setting Value for Pr. 83
9	Get/Set	Rated Frequency,	Setting Value for Pr. 81
15	Get/Set	Base Speed, cf.	Setting Value for Pr. 3

Note: Refer to Vol. 2: 6-29 of DeviceNet Specifications for details.

### (4) Class 0x28 Instance Services

Service Code	Service
0x0E	Get Attribute Single
0x10	Set Attribute Single

## 6. Class 0x29 - Control Supervisor Object

### (1) Class 0x29 Attributes - Instance 0

Note: Not applicable to the FR-E500KND.

### (2) Class 0x29 Services

Note: Not applicable to the FR-E500KND.

### (3) Class 0x29 Instance Attributes Instance 1

No.	Access	Attribute	Value
3	Get/Set	Forward Rotation 0: Stop            1: Forward	0 to 1
4	Get/Set	Reverse Rotation 0: Stop            1: Reverse	0 to 1
6	Get	Status 0: Vendor specific 1: Start up        2: Not Ready 3: Ready            4: Enabled 5: Stopping        6: Fault stop 7: Faulted	0 to 7
7	Get	Forward command 0: Without forward rotation command 1: With forward rotation command	0 to 1
8	Get	Reverse run command 0: Without reverse rotation command 1: With reverse rotation command	0 to 1
9	Get	Ready 0: Communication disabled 1: Communication enabled	0 to 1
10	Get	Faulted 0: No error 0→1: Error occurrence (latch)	0 to 1
12	Get/Set	Error Reset (Note 1) 0: Reset cancel 0→1: Reset execution	0 to 1
15	Get	Operation Command Source Monitor (Note 2) 0: Other than communication 1: Communication	0 to 1
16	Get/Set	Fault Mode (Operation performed when communication stops dead) 0: Error has occurred and stopped	0 to 1
140	Get/Set	Input Assembly	70, 71, 150, 176
141	Get/Set	Output Assembly	20, 21, 100, 126

Note 1. After setting data to 1 and executing a reset, a reset cannot be executed again unless the data is set to 0 once to cancel a reset.

2. This data is updated only after an inverter reset or operation cycle.

3. Refer to Vol. II: 6-29 of DeviceNet Specifications for details.

### (4) Class 0x29 Instance Services

Service Code	Service
0x05	Reset Object Information. (Does not perform inverter reset)
0x0E	Get Attribute Single
0x10	Set Attribute Single

## 7. Class 0x2A - AC Drive Object

### (1) Class 0x2A Attributes - Instance 0

Note: Not applicable to the FR-E500KND.

### (2) Class 0x2A Services

Note: Not applicable to the FR-E500KND.

### (3) Class 0x2A Instance Attributes Instance 1

#### AC Profile Compatibles

No.	Access	Attribute	Value
1	Get	One	1
3	Get	At Reference 1: Speed reached speed command value	0 to 1
6	Get/Set	Drive Mode	0
8	Get/Set	SpeedRef	0 to 0xFFFF
9	Get	Current Actual	0 to 0xFFFF
17	Get	Output Voltage	0 to 0xFFFF
18	Get/Set	AccelerationTime, (Pr. 7)	0 to 3600
19	Get/Set	DecelerationTime, (Pr. 8)	0 to 3600
20	Get/Set	LowSpeedLimit, (Pr. 2)	0 to 0xFFFF
21	Get/Set	HighSpeedLimit, (Pr. 1)	0 to 0xFFFF
29	Get	Speed Command Source Monitor 0: Other than DeviceNet communication operation 1: DeviceNet communication operation	0 to 1

Note: 1. This data is updated only after an inverter reset or power cycle.  
2. Refer to Vol. II: 6-30 of DeviceNet Specifications for details.

The following variables and parameters are specific to the FR-E500KND.

#### FR-E500KND System Environment Variables

No.	Access	Attribute	Value
101	Set	Inverter reset	1
102	Set	Parameter Clear	0x965A
103	Set	Parameter All Clear	0x99AA
105	Set	Parameter Clear (Ex Com Pr)	0x5A96
106	Set	Parameter All Clear (Ex Com Pr)	0xAA99
112	Get/Set	Running Frequency (RAM) (Note)	30.00Hz
113	Set	Running Frequency (E <sup>2</sup> PROM) (Note)	30.00Hz
114	Get/Set	Inverter Status/Control Input Command	0 to 0xFFFF
120	Get/Set	Operating Mode/Inverter Config (1) Get 1: PU operation 4: DeviceNet communication operation (2) Set 0x11: PU operation 0x14: DeviceNet communication operation	–

Note: Write to No.112 and No.113 can be read out from No.112.

#### FR-E500KND Real Time Parameters

No.	Access	Attribute	Value
141	Get/Set	Alarm History 1 (Note)/Alarm History All Clear	0 to 0xFFFF
142	Get	Alarm History 2 (Note)	0 to 0xFFFF
143	Get	Alarm History 3 (Note)	0 to 0xFFFF
144	Get	Alarm History 4 (Note)	0 to 0xFFFF
145	Get	Alarm History 5 (Note)	0 to 0xFFFF
146	Get	Alarm History 6 (Note)	0 to 0xFFFF
147	Get	Alarm History 7 (Note)	0 to 0xFFFF
148	Get	Alarm History 8 (Note)	0 to 0xFFFF
170	Get	Output frequency (Minimum setting increments: 0.01Hz)	0 to 0xFFFF
171	Get	Output Current (Minimum setting increments: 0.01A)	0 to 0xFFFF
172	Get	Output Voltage (Minimum setting increments: 0.1V)	0 to 0xFFFF

Note: For the alarm history, refer to the alarm code list on the next page.

### Alarm Code List

Code	Definition	Code	Definition	Code	Definition
0x10	OC1	0x80	GF	0xF5	E5
0x11	OC2	0x81	LF	0xF6	E6
0x12	OC3	0x90	OHT	0xF7	E7
0x20	OV1	0xB0	PE	0xF8	E8
0x21	OV2	0xB1	PUE	0xF9	E9
0x22	OV3	0xB2	RET	0xFA	E10
0x30	THT	0xC0	CPU	0xFB	E11
0x31	THM	0xF0	E0	0xFC	E12
0x40	FIN	0xF1	E1	0xFD	E13
0x41	FAN	0xF2	E2	0xFE	E14
0x60	OLT	0xF3	E3	0xFF	E15
0x70	BE	0xF4	E4		

Note: Please refer to Section for explanation of Alarm Codes.

#### (4) Class 0x2A Instance Services

Service Code	Service
0x0E	Read Attribute Value
0x10	Write Attribute Value

## 8. Class 0x66 - E500 Extended Object 1

### (1) Class 0x66 Attributes - Instance 0

Note: Not applicable to the FR-E500KND.

### (2) Class 0x66 Services

Note: Not applicable to the FR-E500KND.

### (3) Class 0x66 Instance Attributes Instance 1

#### Parameters (Pr. 0 = No.10)

No.	Access	Attribute	Default Setting
10	Get/Set	Pr. 0 Torque Boost	(Note 2)
11	Get/Set	Pr. 1 Maximum Frequency	(Note 2)
12	Get/Set	Pr. 2 Minimum Frequency	0.00Hz
13	Get/Set	Pr. 3 Base Frequency	60.00Hz
14	Get/Set	Pr. 4 Multi Speed (high speed)	60.00Hz
15	Get/Set	Pr. 5 Multi Speed (middle speed)	30.00Hz
16	Get/Set	Pr. 6 Multi Speed (low speed)	10.00Hz
17	Get/Set	Pr. 7 Acceleration Time	(Note 2)
18	Get/Set	Pr. 8 Deceleration Time	(Note 2)
19	Get/Set	Pr. 9 Electronic Thermal O/L Relay	(Note 2)
20	Get/Set	Pr. 10 DC Injection Brake Operation Frequency	3.00Hz
21	Get/Set	Pr. 11 DC Injection Brake Operation Time	0.5s
22	Get/Set	Pr. 12 DC Injection Brake Voltage	6.0% (Note 2)
23	Get/Set	Pr. 13 Starting Frequency	0.50Hz
24	Get/Set	Pr. 14 Applied Load Selection	0
28	Get/Set	Pr. 18 High Speed Maximum Frequency Limit	(Note 2)
29	Get/Set	Pr. 19 Base Frequency Voltage	(Note 3)
30	Get/Set	Pr. 20 Acceleration/Deceleration Reference Frequency	60.00Hz
31	Get/Set	Pr. 21 Acceleration/Deceleration Time Increments (Note 4)	0
32	Get/Set	Pr. 22 Stall Prevention Operation Level	150.0%
33	Get/Set	Pr. 23 Stall Prevention Operation Level at Double Speed	(Note 3)
34	Get/Set	Pr. 24 Multi-Speed Setting (Speed 4)	(Note 3)
35	Get/Set	Pr. 25 Multi-Speed Setting (Speed 5)	(Note 3)
36	Get/Set	Pr. 26 Multi-Speed Setting (Speed 6)	(Note 3)
37	Get/Set	Pr. 27 Multi-Speed Setting (Speed 7)	(Note 3)

No.	Access	Attribute	Default Setting
39	Get/Set	Pr. 29 Acceleration/Deceleration Pattern	0
40	Get/Set	Pr. 30 Regenerative Function Selection	0
41	Get/Set	Pr. 31 Frequency Jump 1A	(Note 3)
42	Get/Set	Pr. 32 Frequency Jump 1B	(Note 3)
43	Get/Set	Pr. 33 Frequency Jump 2A	(Note 3)
44	Get/Set	Pr. 34 Frequency Jump 2B	(Note 3)
45	Get/Set	Pr. 35 Frequency Jump 3A	(Note 3)
46	Get/Set	Pr. 36 Frequency Jump 3B	(Note 3)
47	Get/Set	Pr. 37 Speed Display	0
48	Get	Pr. 38 Special	
49	Get	Pr. 39 Special	
51	Get/Set	Pr. 41 Up-to-Frequency Sensitivity	10.0
52	Get/Set	Pr. 42 Output Frequency Detection	6.00 Hz
53	Get/Set	Pr. 43 Output Frequency Detection for Reverse Rotation	(Note 3)
54	Get/Set	Pr. 44 Second Acceleration/Deceleration Time	5.0s
55	Get/Set	Pr. 45 Second Deceleration Time	(Note 3)
56	Get/Set	Pr. 46 Second Torque Boost	(Note 3)
57	Get/Set	Pr. 47 Second V/F (base frequency)	(Note 3)
58	Get/Set	Pr. 48 Second Electronic Overcurrent Protection	(Note 3)
62	Get/Set	Pr. 52 PU Main Display Data Selection	0
67	Get/Set	Pr. 57 Restart Coasting Time	(Note 3)
68	Get/Set	Pr. 58 Restart Cushion Time	1.0s
70	Get/Set	Pr. 60 Shortest Acceleration/deceleration Mode	0
71	Get/Set	Pr. 61 Reference Current	(Note 3)
72	Get/Set	Pr. 62 Reference Current for Acceleration	(Note 3)
73	Get/Set	Pr. 63 Reference Current for Deceleration	(Note 3)
75	Get/Set	Pr. 65 Retry Selection	0
76	Get/Set	Pr. 66 Stall Prevention Operation Level Reduction Starting Frequency	60.00Hz
77	Get/Set	Pr. 67 Number of Retries at Alarm Occurrence	0
78	Get/Set	Pr. 68 Retry Waiting Time	1.0s
79	Get/Set	Pr. 69 Retry Count Display Erasure	0
80	Get/Set	Pr. 70 Special Regenerative Brake Duty	0.0%
81	Get/Set	Pr. 71 Applied Motor	0
82	Get/Set	Pr. 72 PWM Frequency Selection	1kHz
85	Get/Set	Pr. 75 Reset Selection/Disconnected PU Detection/PU Stop Selection	14
87	Get	Pr. 77 Parameter Write Disable Selection	0
88	Get/Set	Pr. 78 Reverse Rotation Prevention Selection	0



No.	Access	Attribute	Default Setting
89	Get	Pr. 79 Operation Mode Selection	2
90	Get/Set	Pr. 80 Motor Capacity	(Note 3)
92	Get/Set	Pr. 82 Motor Exciting Current	(Note 3)
93	Get/Set	Pr. 83 Rated Motor Voltage	(Note 2)
94	Get/Set	Pr. 84 Rated Motor Frequency	60.00Hz
95	Get/Set	Pr. 85 Special (Note 1)	
96	Get/Set	Pr. 86 Special (Note 1)	
100	Get/Set	Pr. 90 Motor Constant (R1)	(Note 3)
106	Get/Set	Pr. 96 Auto Tuning Setting/Status	0
127	Get/Set	Pr. 117 Station Number	0
128	Get/Set	Pr. 118 Communication Speed	192
129	Get/Set	Pr. 119 Stop Bit Length/Data Length	1
130	Get/Set	Pr. 120 Parity Check Presence/Absence	2
131	Get/Set	Pr. 121 Number Of Comms Retries	1
132	Get/Set	Pr. 122 Communication Check Time Interval	0.0s
133	Get/Set	Pr. 123 Waiting Time Setting	(Note 3)
134	Get/Set	Pr. 124 CR • LF Presence/Absence Selection	1
155	Get/Set	Pr. 145 Parameter Unit Language Switching	(Note 2)
160	Get/Set	Pr. 150 Output Current Detection Level	150.0%
161	Get/Set	Pr. 151 Output Current Detection Period	0.0s
162	Get/Set	Pr. 152 Zero Current Detection Level	5.0%
163	Get/Set	Pr. 153 Zero Current Detection Period	0.50s
166	Get/Set	Pr. 156 Stall Prevention Operation Selection	0
170	Get/Set	Pr. 160 User Group Read Selection	0
178	Get	Special (Note 1)	
179	Get	Special (Note 1)	
181	Get/Set	Pr. 171 Actual Operation Hour Meter Clear	0
183	Get/Set	Pr. 173 User Group 1 Registration	0
184	Get/Set	Pr. 174 User Group 1 Deletion	0
185	Get/Set	Pr. 175 User Group 2 Registration	0
186	Get/Set	Pr. 176 User Group 2 Deletion	0
190	Get/Set	Pr. 180 (RL) Function Selection	0
191	Get/Set	Pr. 181 (RM) Function Selection	1
192	Get/Set	Pr. 182 (RH) Function Selection	2
193	Get/Set	Pr. 183 MRS Terminal (MRS) Function Selection	6
200	Get/Set	Pr. 190 (RUN) Function Selection	0
201	Get/Set	Pr. 191 (FU) Function Selection	4
202	Get/Set	Pr. 192 ABC Terminal (ABC) Function Selection	99
212	Get/Set	Pr. 232 Multi-Speed Setting (Speed 8)	(Note 3)
213	Get/Set	Pr. 233 Multi-Speed Setting (Speed 9)	(Note 3)

No.	Access	Attribute	Default Setting
214	Get/Set	Pr. 234 Multi-Speed Setting (Speed 10)	(Note 3)
215	Get/Set	Pr. 235 Multi-Speed Setting (Speed 11)	(Note 3)
216	Get/Set	Pr. 236 Multi-Speed Setting (Speed 12)	(Note 3)
217	Get/Set	Pr. 237 Multi-Speed Setting (Speed 13)	(Note 3)
218	Get/Set	Pr. 238 Multi-Speed Setting (Speed 14)	(Note 3)
219	Get/Set	Pr. 239 Multi-Speed Setting (Speed 15)	(Note 3)
220	Get/Set	Pr. 240 Soft-PWM Setting	1
224	Get/Set	Pr. 244 Cooling Fan Operation Selection	0
225	Get/Set	Pr. 245 Rated Motor Slip	(Note 3)
226	Get/Set	Pr. 246 Slip Compensation Response Time	0.5s
227	Get/Set	Pr. 247 Constant-Output Region Slip Compensation Selection	(Note 3)
229	Get/Set	Pr. 249 Ground Fault Detection at Start	0
230	Get/Set	Pr. 250 Stop Selection	(Note 3)

- Note: 1. Parameters marked “Special” should not be changed under normal operating conditions. Improper inverter operation and damage to equipment may occur. Contact technical support for further information
2. Some default settings depend on the capacity or type of the inverter.
3. The default settings 65535, 6553.5 and 655.35 indicate that the function is invalid. These settings will be "9999" when viewed via the parameter unit.
4. Changing the value of No. 31 will change the setting increments of the inverter but this will not be reflected on DeviceNet™.

**(4) Class 0x66 Instance Services**

Service Code	Service
0x0E	Get Attribute Single
0x10	Set Attribute Single

## 9. Class 0x67 - E520 Extended Object 2

### (1) Class 0x67 Attributes - Instance 0

Note: Not applicable to the FR-E500KND.

### (2) Class 0x67 Services

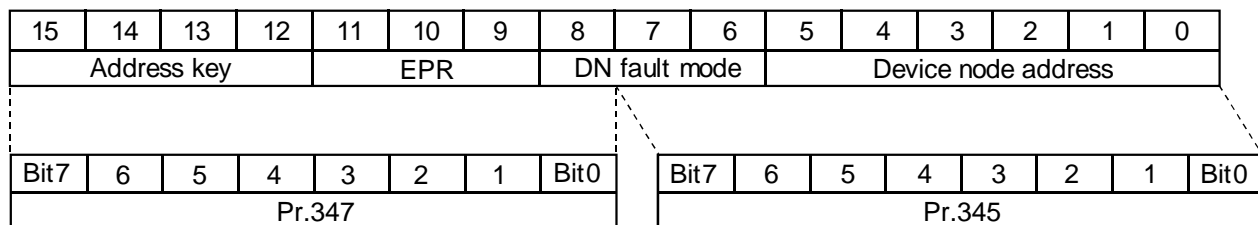
Note: Not applicable to the FR-E500KND.

### (3) Class 0x67 Instance Attributes Instance 1

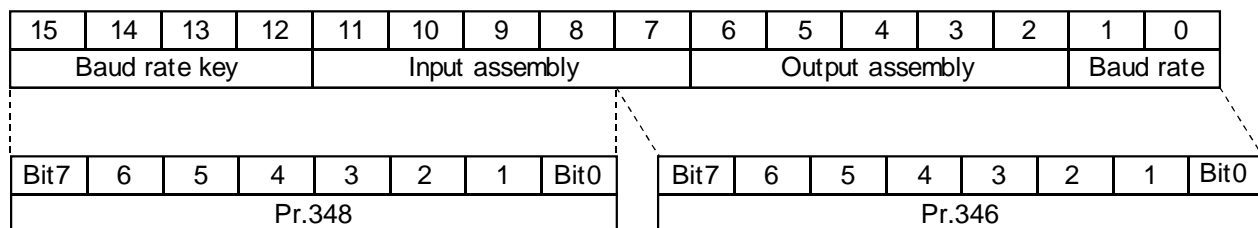
FR-E500KND Parameters

No.	E500 Pr.	Access	Attribute
45	Pr. 345	Get/Set	DeviceNet Address Startup Data (Lower-order byte)
46	Pr. 346	Get/Set	DeviceNet Baudrate Startup Data (Lower-order byte)
47	Pr. 347	Get/Set	DeviceNet Address Startup Data (Higher-order byte)
48	Pr. 348	Get/Set	DeviceNet Baudrate Startup Data (Higher-order byte)

Pr. 345 and Pr. 347 are bit-mapped parameters and are defined as follows.



Pr. 346 and Pr. 348 are bit-mapped parameters and are defined as follows.



**Definition of each registration**

Name	Description	Definition	Default Setting
Watch dog timeout operation (WDA) (Note)	DeviceNet connection object (Class code 0x05) instance 2 attribute 12	0 = Shift to timeout 1 = Automatic deletion 2 = Automatic reset	0
DN fault mode	Supports control management object (Class code 0x29) instance attribute 16, DN fault mode	0 = Fault + stop 1 = Ignore	0
Input assembly	Assemble ID value used for connection object. (Class code 0x05) instance attribute 16, consumed_connection_path	Assemble instance ID 0 = 0x46 (70) 4byteMode 1 = 0x47 (71) 4byteMode 6 = 0xB0 (176) 6byteMode 8 = 0x96 (150) 8byteMode	1
Output assembly	Assemble ID value used for connection object. (Class code 0x05) instance attribute 14, produced_connection_path	Assemble instance ID 0 = 0x14 (20) 4byteMode 1 = 0x15 (21) 4byteMode 6 = 0x7E (126) 6byteMode 8 = 0x64 (100) 8byteMode	1
Baud rate	DeviceNet object value (Class code 0x03 instance attribute 2, baud rate)	0 = 125kbps 1 = 250kbps 2 = 500kbps	0
Device address	DeviceNet object value (Class code 0x03 instance attribute 1, MAC ID)	Node address: range is 0 to 63 (Same as attribute definition)	63
Address key	Internal confirmation	1010 - preset; No other definitions	1010
Baud rate	Internal confirmation	0101 - preset; No other definitions	0101

Note: The parameter setting will be changed back to the factory setting (0) when reconnected after a disconnection.

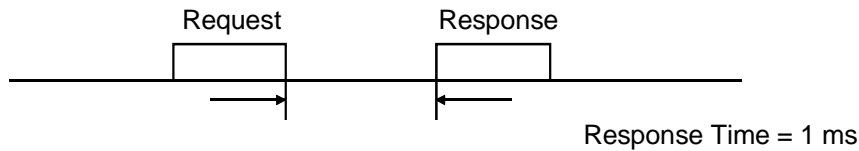
**(4) Class 0x67 Instance Services**

Service Code	Service
0x0E	Get Attribute Single
0x10	Set Attribute Single

## 10. Response Timing

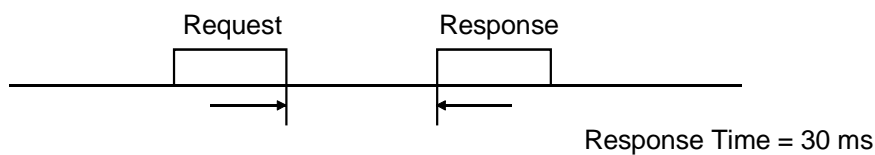
### Item 1 Polling-Reading and Request Without Changing State:

Explicit Messaging (G2 & G3)-Get-Attribute-Reading Data:

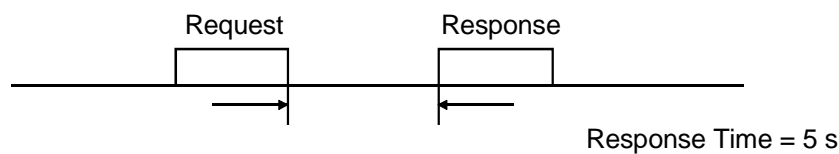


### Item 2. Polling-Writing and Request With Changing State:

Explicit Messaging (G2 & G3)-Set-Attribute-Writing Data  
(Excluding Items 3 & 4):



### Item 3. PrClr, PrAllClr, PrClr(ECP), PrAllClr(ECP):



## 11. Recommendation For Software Developers

For software developers only:

- Make a handshake procedure, send a request, wait for response, then go to next request.
- Set the waiting time between messages on the basis of the above FR-E500KND specifications. For example, set 1ms for read and 30ms for write.

## APPENDIX 2 Electronic Data Sheets (EDS files)

The following method is recommended to get the EDS file designed for the FR-E500KND type inverter.

- Download from the Internet.  
The EDS file can be downloaded at no charge from the Open DeviceNet Vender Association, Inc. home page:  
<http://www.odva.org/>

Please consult your DeviceNet configuration software instruction manual for the proper installation of the EDS file.

# APPENDIX 3 DeviceNet Parameters

## APPENDIX

No.	Function	FR- E520 KND	EDS	COM MON	Object	Attribute /service	Attr id/ svc code	Attr/ svc name
0	Torque Boost	•	•		E500_66	attrib	10	
1	Maximum Frequency	•	•	•	ACDrive	attrib	21	HiSpd Limit
		•	•		E500_66	attrib	11	
2	Minimum Frequency	•	•	•	ACDrive	attrib	20	LoSpd Limit
		•	•		E500_66	attrib	12	
3	Base Frequency	•	•	•	MotrData/ ACMotrInst	attrib	9	Rated f
		•	•		E500_66	attrib	13	
4	Multi-Speed Setting (High Speed)	•	•		E500_66	attrib	14	
5	Multi-Speed Setting (Middle Speed)	•	•		E500_66	attrib	15	
6	Multi-Speed Setting (Low Speed)	•	•		E500_66	attrib	16	
7	Acceleration Time	•	•	•	ACDrive	attrib	18	Acc t
		•	•		E500_66	attrib	17	
8	Deceleration Time	•	•	•	ACDrive	attrib	19	Dec t
		•	•		E500_66	attrib	18	
9	Electrical Thermal O/L Relay	•	•		E500_66	attrib	19	
10	DC Injection Brake Operation Frequency	•	•		E500_66	attrib	20	
11	DC Injection Brake Operation Time	•	•		E500_66	attrib	21	
12	DC Injection Brake Voltage	•	•		E500_66	attrib	22	
13	Starting Frequency	•	•		E500_66	attrib	23	
14	Load Pattern Selection	•	•		E500_66	attrib	24	
18	High-Speed Maximum Frequency	•	•	•	ACDrive	attrib	21	HiSpd Limit
		•	•		E500_66	attrib	28	
19	Base Frequency Voltage	•	•	•	MotrData/ ACMotrInst	attrib	7	Rated V
		•	•		E500_66	attrib	29	
20	Acceleration/Deceleration Reference Frequency	•	•		E500_66	attrib	30	
21	Acceleration/Deceleration Time Increments	•	•		E500_66	attrib	31	
22	Stall Prevention Operation Level	•	•		E500_66	attrib	32	
23	Stall Prevention Operation Level at Double Speed	•	•		E500_66	attrib	33	
24	Multi-Speed Setting (Speed 4)	•	•		E500_66	attrib	34	
25	Multi-Speed Setting (Speed 5)	•	•		E500_66	attrib	35	
26	Multi-Speed Setting (Speed 6)	•	•		E500_66	attrib	36	
27	Multi-Speed Setting (Speed 7)	•	•		E500_66	attrib	37	

No.	Function	FR- E520 KND	EDS	COM MON	Object	Attribute /service	Attr id/ svc code	Attr/ svc name
29	Acceleration/Deceleration Pattern	•	•		E500_66	attrib	39	
30	Regenerative Function Selection	•	•		E500_66	attrib	40	
31	Frequency Jump 1A	•	•		E500_66	attrib	41	
32	Frequency Jump 1B	•	•		E500_66	attrib	42	
33	Frequency Jump 2A	•	•		E500_66	attrib	43	
34	Frequency Jump 2B	•	•		E500_66	attrib	44	
35	Frequency Jump 3A	•	•		E500_66	attrib	45	
36	Frequency Jump 3B	•	•		E500_66	attrib	46	
37	Speed Display	•	•		E500_66	attrib	47	
41	Up-to-Frequency Sensitivity	•	•		E500_66	attrib	51	
42	Output Frequency Detection	•	•		E500_66	attrib	52	
43	Output Frequency Detection for Reverse Rotation	•	•		E500_66	attrib	54	
44	Second Acceleration/Deceleration Time	•	•		E500_66	attrib	54	
45	Second Deceleration Time	•	•		E500_66	attrib	55	
46	Second Torque Boost	•	•		E500_66	attrib	56	
47	Second V/F (base frequency)	•	•		E500_66	attrib	57	
48	Second Electronic Overcurrent Protection	•	•		E500_66	attrib	60	
52	PU Main Display Data Selection	•	•		E500_66	attrib	62	
57	Restart Coasting Time	•	•		E500_66	attrib	67	
58	Restart Cushion Time	•	•		E500_66	attrib	68	
60	Shortest Acceleration/deceleration Mode	•	•		E500_66	attrib	70	
61	Reference Current	•	•		E500_66	attrib	71	
62	Reference Current for Acceleration	•	•		E500_66	attrib	72	
63	Reference Current for Deceleration	•	•		E500_66	attrib	73	
65	Retry Selection	•	•		E500_66	attrib	75	
66	Stall Prevention Operation Level Reduction Starting Frequency	•	•		E500_66	attrib	76	
67	Number of Retries at Alarm Occurrence	•	•		E500_66	attrib	77	
68	Retry Waiting Time	•	•		E500_66	attrib	78	
69	Retry Count Display Erasure	•	•		E500_66	attrib	79	
70	Special Regenerative Brake Duty	•	•		E500_66	attrib	80	
71	Applied Motor	•	•		E500_66	attrib	81	
72	PWM Frequency Selection	•	•		E500_66	attrib	82	
75	Reset Selection/PU Disconnection Detection	•	•		E500_66	attrib	85	
77	Parameter Write Disable Selection	•	•		E500_66	attrib	87	
78	Reverse Rotation Prevention Selection	•	•		E500_66	attrib	88	
79	Operation Mode Selection	•	•		E500_66	attrib	89	



No.	Function	FR- E520 KND	EDS	COM MON	Object	Attribute /service	Attr id/ svc code	Attr/ svc name
80	Motor Capacity	•	•		E500_66	attrib	90	
82	Motor Exciting Current	•	•		E500_66	attrib	92	
83	Rated Motor Voltage	•	•	•	MotrData/ ACMotrInst	attrib	7	Rated V
		•	•		E500_66	attrib	93	
84	Rated Motor Frequency	•	•	•	MotrData/ ACMotrInst	attrib	9	Rated f
		•	•		E500_66	attrib	94	
90	Motor Constant (R1)	•	•		E500_66	attrib	100	
96	Auto Tuning Setting/Status	•	•		E500_66	attrib	106	
117	Station Number	•	•		E500_66	attrib	127	
118	Communication Speed	•	•		E500_66	attrib	128	
119	Stop Bit Length/Data Length	•	•		E500_66	attrib	129	
120	Parity Check Presence/Absence	•	•		E500_66	attrib	130	
121	Number Of Communication Retries	•	•		E500_66	attrib	131	
122	Communication Check Time Interval	•	•		E500_66	attrib	132	
123	Waiting Time Setting	•	•		E500_66	attrib	133	
124	CR, LF Presence/Absence Selection	•	•		E500_66	attrib	134	
150	Output Current Detection Level	•	•		E500_66	attrib	160	
151	Output Current Detection Period	•	•		E500_66	attrib	161	
152	Zero Current Detection Level	•	•		E500_66	attrib	162	
153	Zero Current Detection Period	•	•		E500_66	attrib	163	
156	Stall Prevention Operating Selection	•	•		E500_66	attrib	166	
168	Reserved	•	•		E500_66	attrib	178	
169	Reserved	•	•		E500_66	attrib	179	
160	User Group Read Selection	•	•		E500_66	attrib	170	
171	Actual Operation Hour Meter Clear	•	•		E500_66	attrib	181	
173	User Group 1 Registration	•	•		E500_66	attrib	183	
174	User Group 1 Deletion	•	•		E500_66	attrib	184	
175	User Group 2 Registration	•	•		E500_66	attrib	185	
176	User Group 2 Deletion	•	•		E500_66	attrib	186	
180	(RL) Function Selection	•	•		E500_66	attrib	190	
181	(RM) Function Selection	•	•		E500_66	attrib	191	
182	(RH) Function Selection	•	•		E500_66	attrib	192	
183	MRS Terminal (MRS) Function Selection	•	•		E500_66	attrib	193	
190	(RUN) Function Selection	•	•		E500_66	attrib	200	
191	(FU) Function Selection	•	•		E500_66	attrib	201	
192	A, B, C Terminal (ABC) Function Selection	•	•		E500_66	attrib	202	
232	Multi-Speed Setting (Speed 8)	•	•		E500_66	attrib	212	
233	Multi-Speed Setting (Speed 9)	•	•		E500_66	attrib	213	
234	Multi-Speed Setting (Speed 10)	•	•		E500_66	attrib	214	
235	Multi-Speed Setting (Speed 11)	•	•		E500_66	attrib	215	

No.	Function	FR- E520 KND	EDS	COM MON	Object	Attribute /service	Attr id/ svc code	Attr/ svc name
236	Multi-Speed Setting (Speed 12)	•	•		E500_66	attrib	216	
237	Multi-Speed Setting (Speed 13)	•	•		E500_66	attrib	217	
238	Multi-Speed Setting (Speed 14)	•	•		E500_66	attrib	218	
239	Multi-Speed Setting (Speed 15)	•	•		E500_66	attrib	219	
240	Soft-PWM Selection	•	•		E500_66	attrib	220	
250	Stop Selection	•	•		E500_66	attrib	230	
345	DeviceNet Address Startup Data (Lower byte)	•	•		E500_67	attrib	45	
346	DeviceNet Baudrate Startup Data (Lower byte)	•	•		E500_67	attrib	46	
347	DeviceNet Address Startup Data (Higher byte)	•	•		E500_67	attrib	47	
348	DeviceNet Baudrate Startup Data (Higher byte)	•	•		E500_67	attrib	48	
	Inverter Reset	•	•		ACDrive	attrib	101	
	Parameter Clear	•	•		ACDrive	attrib	102	
	Parameter All Clear	•	•		ACDrive	attrib	103	
	Parameter Clear (Ex Com Pr)	•	•		ACDrive	attrib	105	
	Parameter All Clear (Ex Com Pr)	•	•		ACDrive	attrib	106	
	Running Frequency (RAM)	•	•		ACDrive	attrib	112	
	Running Frequency (E <sup>2</sup> PROM)	•	•		ACDrive	attrib	113	
	Inverter Status/Control Input Cmd	•	•		ACDrive	attrib	114	
	Op Mode/Inverter Configuration	•	•		ACDrive	attrib	120	
	Alarm History 1/ Alarm History All Clear	•	•		ACDrive	attrib	141	

# APPENDIX 4 Data Code List

Function	Parameter Number	Name	Data Code		Link Parameter Extension Setting (Data Code 7F/FF)
			Read	Write	
Basic functions	0	Torque boost	00	80	0
	1	Maximum frequency	01	81	0
	2	Minimum frequency	02	82	0
	3	Base frequency	03	83	0
	4	Multi-speed setting (high speed)	04	84	0
	5	Multi-speed setting (middle speed)	05	85	0
	6	Multi-speed setting (low speed)	06	86	0
	7	Acceleration time	07	87	0
	8	Deceleration time	08	88	0
	9	Electronic thermal O/L relay	09	89	0
Standard operation functions	10	DC injection brake operation frequency	0A	8A	0
	11	DC injection brake operation time	0B	8B	0
	12	DC injection brake voltage	0C	8C	0
	13	Starting frequency	0D	8D	0
	14	Load pattern selection	0E	8E	0
	18	High-speed maximum frequency	12	92	0
	19	Base frequency voltage	13	93	0
	20	Acceleration/deceleration reference frequency	14	94	0
	21	Acceleration/deceleration time increments	15	95	0
	22	Stall prevention operation level	16	96	0
	23	Stall prevention operation level compensation factor at double speed	17	97	0
	24	Multi-speed setting (speed 4)	18	98	0
	25	Multi-speed setting (speed 5)	19	99	0
	26	Multi-speed setting (speed 6)	1A	9A	0
	27	Multi-speed setting (speed 7)	1B	9B	0
	29	Acceleration/deceleration pattern	1D	9D	0
	30	Regenerative function selection	1E	9E	0
	31	Frequency jump 1A	1F	9F	0
	32	Frequency jump 1B	20	A0	0
	33	Frequency jump 2A	21	A1	0
34	Frequency jump 2B	22	A2	0	
35	Frequency jump 3A	23	A3	0	
36	Frequency jump 3B	24	A4	0	
37	Speed display	25	A5	0	
38	Frequency at 5V (10V) input	26	A6	0	
39	Frequency at 20mA input	27	A7	0	

Function	Parameter Number	Name	Data Code		Link Parameter Extension Setting (Data Code 7F/FF)
			Read	Write	
Output terminal functions	41	Up-to-frequency sensitivity	29	A9	0
	42	Output frequency detection	2A	AA	0
	43	Output frequency detection for reverse rotation	2B	AB	0
Second functions	44	Second acceleration/deceleration time	2C	AC	0
	45	Second deceleration time	2D	AD	0
	46	Second torque boost	2E	AE	0
	47	Second V/F (base frequency)	2F	AF	0
	48	Second electronic overcurrent protection	30	B0	0
Display functions	52	PU main display data selection	34	B4	0
Automatic restart functions	57	Restart coasting time	39	B9	0
	58	Restart cushion time	3A	BA	0
Operation selection functions	60	Shortest acceleration/deceleration mode	3C	BC	0
	61	Reference I for intelligent mode	3D	BD	0
	62	Ref. I for intelligent mode accel	3E	BE	0
	63	Ref. I for intelligent mode decel	3F	BF	0
	65	Retry selection	41	C1	0
	66	Stall prevention operation level reduction starting frequency	42	C2	0
	67	Number of retries at alarm occurrence	43	C3	0
	68	Retry waiting time	44	C4	0
	69	Retry count display erasure	45	C5	0
	70	Special regenerative brake duty	46	C6	0
	71	Applied motor	47	C7	0
	72	PWM frequency selection	48	C8	0
	75	Reset selection/disconnected PU detection/PU stop selection	4B	CB	0
	77	Parameter write disable selection	4D	CD	0
	78	Reverse rotation prevention selection	4E	CE	0
	79	Operation mode selection	4F	CF	0
Motor constants	80	Motor capacity	50	D0	0
	82	Motor exciting current	52	D2	0
	83	Rated motor voltage	53	D3	0
	84	Rated motor frequency	54	D4	0
	90	Motor constant (R1)	5A	DA	0
	96	Auto-tuning setting/status	60	E0	0

Function	Parameter Number	Name	Data Code		Link Parameter Extension Setting (Data Code 7F/FF)
			Read	Write	
Communication functions	117	Station number	11	91	1
	118	Communication speed	12	92	1
	119	Stop bit length	13	93	1
	120	Parity check presence/absence	14	94	1
	121	Number of communication retries	15	95	1
	122	Communication check time interval	16	96	1
	123	Waiting time setting	17	97	1
	124	CR • LF presence/absence selection	18	98	1
Additional function	145	Parameter unit language selection	2D	AD	1
Current detection	150	Output current detection level	32	B2	1
	151	Output current detection period	33	B3	1
	152	Zero current detection level	34	B4	1
	153	Zero current detection period	35	B5	1
Sub function	156	Stall prevention operation selection	38	B8	1
Additional function	160	User group read selection	00	80	2
Initial monitor	171	Actual operation hour meter clear	0B	8B	2
User functions	173	User group 1 registration	0D	8D	2
	174	User group 1 deletion	0E	8E	2
	175	User group 2 registration	0F	8F	2
	176	User group 2 deletion	10	90	2
Special	168	Parameters set by manufacturer. Do not set.			
	169				
Terminal (DeviceNet I/O) assignment functions	180	(RL) function selection	14	94	2
	181	(RM) function selection	15	95	2
	182	(RH) function selection	16	96	2
	183	MRS terminal (MRS) function selection	17	97	2
	190	(RUN) function selection	1E	9E	2
	191	(FU) function selection	1F	9F	2
	192	A, B, C terminal (ABC) function selection	20	A0	2

Function	Parameter Number	Name	Data Code		Link Parameter Extension Setting (Data Code 7F/FF)
			Read	Write	
Multi-speed operation	232	Multi-speed setting (speed 8)	28	A8	2
	233	Multi-speed setting (speed 9)	29	A9	2
	234	Multi-speed setting (speed 10)	2A	AA	2
	235	Multi-speed setting (speed 11)	2B	AB	2
	236	Multi-speed setting (speed 12)	2C	AC	2
	237	Multi-speed setting (speed 13)	2D	AD	2
	238	Multi-speed setting (speed 14)	2E	AE	2
	239	Multi-speed setting (speed 15)	2F	AF	2
Sub functions	240	Soft-PWM setting	30	B0	2
	244	Cooling fan operation selection	34	B4	2
	245	Rated motor slip	35	B5	2
	246	Slip compensation response time	36	B6	2
	247	Constant-output region slip compensation selection	37	B7	2
	249	Ground fault detection at start	39	B9	2
Stop selection function	250	Stop selection	3A	BA	2
DeviceNet functions	345	DeviceNet Address Startup Data (Lower byte)	2D	AD	3
	346	DeviceNet Baudrate Startup Data (Lower byte)	2E	AE	3
	347	DeviceNet Address Startup Data (Higher byte)	2F	AF	3
	348	DeviceNet Baudrate Startup Data (Higher byte)	30	B0	3
Display	990	Buzzer control	5A	DA	9
	991	LCD contrast (FR-PU04)	5B	DB	9

## REVISIONS

\*The manual number is given on the bottom left of the back cover.

Print Date	*Manual Number	Revision		
Jul., 1998	IB(NA)-0600008-A	First edition		
Nov., 2000	IB(NA)-0600008-B	Revision of specifications		
Mar., 2001	IB(NA)-0600008-C	<table border="1"><tr><td data-bbox="604 456 815 495">Partial change</td></tr><tr><td data-bbox="604 501 1439 571">Specification changes made with the receipt of ODVA conformance test version A13 certification</td></tr></table>	Partial change	Specification changes made with the receipt of ODVA conformance test version A13 certification
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